Escaping The Woes Through Flow

By

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.
I understand that my thesis may be made electronically available to the public.

Abstract

Recently there has been concern surrounding the relation between flow (a state of deep and effortless concentration) and the development of problematic gaming among players who game to escape noxious mood states (Hull et al., 2013). There is a scarcity of research examining how this relation might extend to smartphone games, and whether this relation is consistent across all game types. The current research first experimentally manipulated an antecedent of flow (the skill-challenge balance) and measured flow within a smartphone game of complex difficulty, followed by determining whether such flow experiences varied as a function of playing to escape. Findings in Chapter 2 showed that games around players level standings were perceived by players as having a more equivalent balance of challenge and skill compared to much harder or much easier games. Yet, both optimally challenging games, and games that were too hard, each induced comparable amounts of flow, positive affect, and urge-to-play with levels exceeding that of the very easy games. The experience of the players supported a "quadrant" model of flow in which the greatest flow was experienced by the most skilled players. Chapter 3, showed that those who played to escape experienced more boredom in everyday life, as well as more problems related to gameplay. Moreover, these bored escape players were more prone to the rewarding aspects of flow – they showed higher positive affect during gameplay compared to those who do not play for escape. In Chapter 4, we demonstrated that these findings translated in part to a popular role-playing game, but not a platform arcade game. Finally, in Chapter 5 we discuss how these findings broaden our understanding of how escape players may be more likely to develop problems through the hedonic appeal of flow. We further discuss how future research can examine flow and its relationship to the development and maintenance of problematic gameplay.

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Dedication

To my Grandfather Alan, who always reminded me to keep my goals in sight.

To Jessamy, and all who have battled any form of addiction.

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Chapter 1: Introduction

1.1 Problematic Videogaming

Video-games have evolved to be one of the most prominent and lucrative forms of entertainment in the world. In fact, in 2018 approximately 23 million Canadians self-identified as gamers (Entertainment Software Association, 2019). There are many forms of gaming, and one of the most popular and lucrative forms include smartphone games, followed by those played on a PC or console. Mobile gaming continues to be the most lucrative subset of gaming in the global games market, garnering $77.2 billion in revenue in 2020 (constituting 48% of the total games market revenue; Wijman, 2020). Mobile gaming is a subset of video-gaming attracting players of all ages. Similarly, console games accrued approximately $34.6 billion in 2019 (Entertainment Software Association Canada, 2019).

Embedded in their rise in popularity is an unfortunate subset of players who struggle with problematic use. A study looking at problematic gameplay found that of the 1,178 individuals surveyed, nearly 8% exhibited problematic patterns of video game play, including dominating thoughts of video games, the need to play longer to achieve the same level of excitement, withdrawal when denied access to video games, and conflict within one's life created by game play (Gentile, 2009). A prominent factor contributing to the onset of such negative consequences includes various structural characteristics that are inherent to gameplay (King, Delfabbro & Griffiths, 2009). Following the World Health Organization's classification of Gaming Disorder as a recognized form of addiction, researchers were prompted to study how structural characteristics contribute to problematic gameplay – especially since structural characteristics are so heterogeneous across game types, and could therefore attract players with different psychological characteristics (King, Koster, & Billieux, 2019). Thus, an examination of structural characteristics across multiple game types (and different platforms) is necessary to determine how such games can fuel problems at the origin of play, and also best inform harm reduction and treatment strategies.

1.2 Examining Motivating Structural Characteristics During Gameplay

1.2.1 Flow

Flow has been described as an enjoyable state of absorption characterized by a distortion of time, and deep effortless concentration in any rewarding activity (Csíkszentmihályi, 1990). Flow is known to increase one’s desire to re-engage in the situation that led to this pleasurable state (Keller, Ringelhan & Blomann, 2011). Flow, however, has a dark side. It has been implicated in the development of behavioural addictions such as gambling (Dixon et al., 2017), as well as video-game play (Keller, Ringelhan & Blomann, 2011). Despite flow’s prominence in the behavioural addiction literature, research surrounding the skill-challenge balance (a key antecedent of flow) is not well understood in the context of gaming, especially mobile gaming. Additionally, the ability of flow to induce the urge to play longer in mobile games remains relatively understudied.

1.2.1.1 Measuring Flow

Although there are several antecedents related to the emergence of flow, the skill-challenge balance is of particular interest since it is a cornerstone of video-game design. In all successful video games, as the skill of players increase, so too does the difficulty of the game. The relation between the skill-challenge balance and optimal flow is classically understood by means of the “channel model” depicted in panel A of Figure 1.1. The model posits that optimal flow is produced whenever the challenge of a game matches the skills of a player. Numerous studies have shown that when skill and challenge are approximately equal, flow is experienced (the diagonal “channel” in Figure 1.1, Panel A; Baumann et al., 2016; Engeser & Reinberg, 2008; Keller & Bless, 2008; Keller, Ringelhan, & Blomann, 2011; Keller, Bless, Blomann & Kleinböhl, 2011; Kennedy et al. 2014; Tozman et al., 2017). In the channel model, it does not matter at what level of skill and challenge players are at. Even for beginners with little skill, so long as they are playing an easy game, flow should be experienced since their minimal skill is matched by the minimal challenge of the game. Moreover, if flow is a highly motivating state (Keller & Bless, 2008; Keller et al., 2011), then even relatively novice players should be motivated to keep playing right from the introduction to a new game.

An alternative to the classic model of flow is what can be described as a quadrant model of flow (see Figure 1.1, panel B)[1]. In this model, flow is experienced only when players feel that they have reached a high level of skill (offset by a high level of challenge). The quadrant model posits that the balance between challenge and skill does not always lead to optimal flow (Abuhamdeh et al., 2012; Lovoll et al., 2014; Moneta & Csikszentmihalyi, 1996; Jin, 2012). For

[1] For the purposes of the current research, we are contrasting a classic model of flow and a more recent extension. Although there is a tertiary model known as the “eight channel model” of flow (Nakamura et al., 2012), the classic and quadrant model of flow appeared to be the most applicable to video-games, and indeed have been informed by research using video games to test their assumptions.

players who feel they have minimal skill and are playing what they feel is a minimally challenging game, apathy rather than flow should ensue.

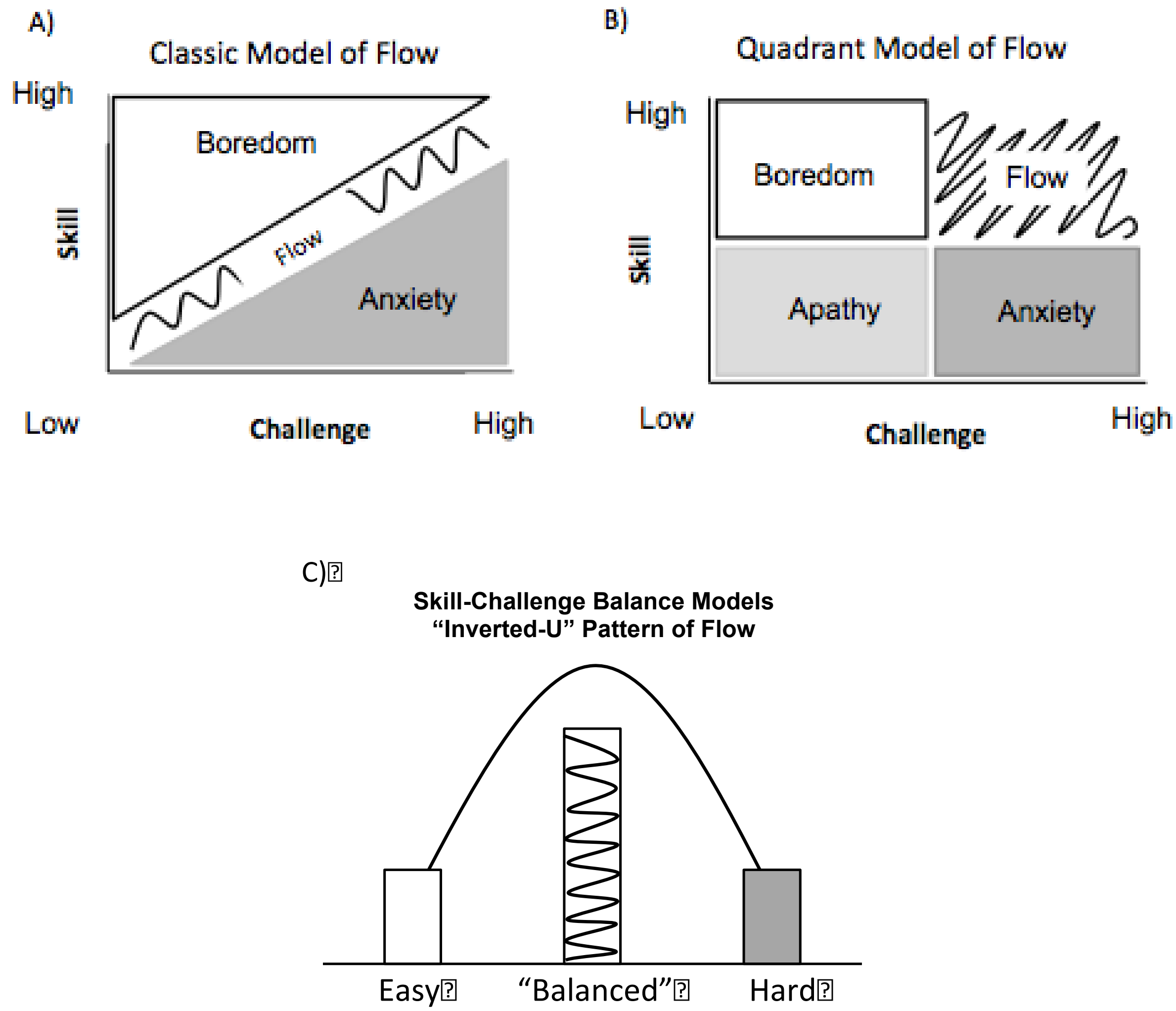

Figure 1.1 Models of Flow based on the skill-balance. A) Classic Model of Flow showing optimal flow emerges with a matching of challenge and skill (Csikszentmihalyi, 1975) B) Quadrant Model of Flow showing optimal flow emerging with high skill and high challenge (Csikszentmihalyi, 1988) C) Inverted-U pattern of flow as posited by the skill-challenge balance models.

Some aspects of particular games would appear to support a quadrant model over the classic model. In games such as poker (a gambling game with a skill component), some contend that it is the skilled players who “might have a better chance to enter the life-affirming flow state” (Palmomaki, Laakasuo, & Salmela, pg. 112, 2016). Such contentions could apply in any gaming situation in which skill improves with experience. For online videogame players, Liu (2017) suggests that “if players believe they have high skill levels and are capable of performing certain actions, they may be more likely to experience flow in the online game environment” (pg. 154). Players who have played more frequently to develop their skill are at a point where they can take on higher game demands confidently. These players would fall in the upper-right “optimal flow” quadrant of the model.

Empirical support for the notion that flow within video games is engendered by the balance of challenge and skill comes from studies which manipulate how challenging the game is by increasing or decreasing the *speed* at which players must play (Baumann et al., 2016; Engeser & Reinberg, 2008; Keller & Bless, 2008; Keller, Ringelhan, & Blomann, 2011; Keller, Bless, Blomann & Kleinböhl, 2011; Kennedy et al. 2014; Tozman et al., 2017; Jin., 2012). For example, consider a skilled player, playing the classic arcade game Tetris in which players must rotate variously shaped blocks so that they form solid, gapless rows. The game can be made too easy by having the shapes fall very slowly, or too hard by having the shapes fall so quickly that even experienced players cannot rotate and align shapes into their optimal winning positions. When speed of play is manipulated, an inverted-U relation between the perceived skill-challenge balance and flow is produced (Baumann et al., 2016; Engeser & Reinberg, 2008; Keller & Bless, 2008; Keller, Ringelhan, & Blomann, 2011; Keller et al., 2011; Kennedy et al. 2014; Tozman et al., 2017; Vuorre & Metcalfe, 2016). Specifically, optimal flow is produced when the speed-based demands matches the player's skill, and less flow ensues when skills far exceed demands (e.g., slow-paced and too easy) or demands far exceed skills (e.g., far too fast-paced and hence too difficult). These relations are depicted in Figure 1.1 Panel C. A heightened desire to re-engage in the activity appears to only be experienced at the apex of the inverted U flow function (Keller & Bless, 2011). That is the urge to keep playing appears to be maximized by flow.

In both the classic and quadrant models of flow, there are clear predictions concerning boredom. Both models posit that for games that players feel are far too easy, boredom should ensue. For games that are too hard "anxiety" should ensue (Peifer et al., 2014; Keller et al., 2012). One problem with using the label anxiety as a descriptor involves its relation with arousal which is known to have motivational effects on game play. For example, for many types of video games, those playing at their current level may show arousal/anxiety as they become anxious about whether or not they will level-up. Since games are designed to match difficulty to the players skill – anxiety may be induced in the flow quadrant as well as in the too-difficult quadrant. Previous research (Larche, Musielak & Dixon, 2017) also suggests that high arousal is associated with just failing to "level up" (a near miss outcome) – a finding which is more aligned with the balance of challenge and skill in the flow quadrant than the too-difficult quadrant. These different sources of arousal may complicate predictions concerning which quadrants are associated with "anxiety". We prefer the term "frustration" instead of anxiety in depictions of the models. Specifically, when challenge far exceeds skill, frustration ensues (Nakamura, Tse & Shankland, 2012; Jin, 2011). For frustration, the predictions are clear. For games that are too easy – frustration should be minimal, and for games that are balanced, there may be mild frustration from not leveling up. For games that are obviously too hard, frustration should be high.

In developing both the classic and quadrant models, in order to demonstrate the skill-challenge balance and its relation to flow the research method of choice was to vary the difficulty of games by varying the speed of play (slow play = too easy, moderate speed = balanced, very fast speeds = too hard; Baumann et al., 2016; Engeser & Reinberg, 2008; Keller & Bless, 2008; Keller, Ringelhan, & Blomann, 2011; Keller, Bless, Blomann & Kleinböhl, 2011; Kennedy et al. 2014; Tozman et al., 2017; Jin, 2012). Importantly, increasing speed is not the only way to make games more difficult. Some games characterize difficulty based on the level of decision-making complexity. Consider for example the immensely popular puzzle game Candy-Crush. Speed of play is irrelevant. Rather, in each level of the game, the player must achieve a specific objective within a limited number of moves before the player can unlock the next level. The objectives can include bringing a certain number of ‘ingredient’ symbols to the bottom of the game matrix (in game play players are instructed to “Collect all 6 ingredients!”), or ‘freeing’ candy symbols encased in ‘jelly’ tiles (e.g. “Clear all the jellies!”). If the player makes the appropriate combination of moves to meet the objective within the allotted number of moves, they level up. This game, like many others uses what is called a ramping structure, such that as they level up, the puzzles become more complex and the game becomes progressively harder – in flow terminology, as player skills improve, the game elevates the challenge to maintain the optimal skill-challenge balance.

The effects of perturbing the skill-challenge balance has not been assessed in a mobile game like Candy-Crush in which challenge is manipulated by the complexity of the game. It is also unclear whether the experience of flow in a game like Candy-Crush occurs equally for unskilled players, playing an easy game (i.e., where flow should still occur according to the classic model) or is more preferentially experienced by those who feel more highly skilled (the quadrant model). Thus in Experiment 1, we sought to clarify the relationship between the skill-challenge balance and flow in the context of Candy Crush. In Experiment 2, we aimed to replicate these findings.

1.2.2 Flow, Variable Ratio Reinforcement and Motivation

Flow in itself is characterized as a motivating state (Keller & Bless, 2008; Keller et al., 2011). In considering the urge to play, flow is only in part responsible for the motivation and enjoyment experienced during play. Specifically, it is also important to consider the schedules or reinforcement to which players are exposed. Many games employ a variable-ratio (VR) schedule of reward delivery – a schedule in which rewards are delivered in an unpredictable sequence. VR schedules have been shown to be important for maintaining gaming behaviour (Haw, 2008; Braun & Giroux, 1989; Hopson, 2001). When one manipulates game difficulty, one also will change the schedule of reinforcement. In games where skills far exceed the game challenges wins are all but assured, and are, therefore, predictable. In games that are far too hard, wins are so infrequent that they too are predictable – players can predict with high fidelity that they are not going to be rewarded. It is only when challenges match (or are slightly above) the skill level of a player that rewards become unpredictable. In this way the unpredictable onset of winning surfacing from optimally challenging games may combine with optimal flow and arousal to make gameplay more appealing, and subsequently motivating.

This conception may be tested by comparing positive affect. While it is self-evident that winning may lead to greater positive affect than losing, if the balance of skill and challenge induces both flow *and* a variable reinforcement reward schedule, it suggests that winning an easy game may lead to less positive affect than winning a more challenging game. Hence, positive affect is not all about winning, but the circumstances in which the win occurred. Succinctly, a win devoid of challenge may induce some positive affect, but not nearly as much as a win in which the player overcame a myriad of challenging situations. This possibility can be empirically assessed by comparing positive affect levels following wins during a ridiculously easy (guaranteeing a win) game versus a more challenging game.

There are two separate aspects to the assessment of motivation. In Experiment 1 we focus on one's intention or "urge-to-play" following the experience of a game. Another way to assess motivation includes capturing how players may act on this urge. This approach was used in a study by Keller, Ringlehan and Blomann (2011) examining the relation between flow, enjoyment and motivation. It featured a five-minute free-choice period following a trivia game task where participants had the option to re-engage in the same game, read a magazine, or doing nothing at all. Participants were randomly assigned to one of three potential difficulty levels – either a level that was too easy, too hard, or a level where the challenges adequately match their skill level. More players opted to re-engage in the trivia game when difficulty of the game matched their skills (hence producing higher flow) compared to players who were assigned to play a version of the same trivia game that was too easy or too hard. Accordingly, in Experiment 2 we predicted that players would choose to continue playing a game in which there was a balance of challenge and skill (conducive to flow) over an easy game that should trigger less flow. To recap, in

Experiment 1 and Experiment 2 we aimed to assess the motivational impact of flow by assessing the degree of urge-to-play following games of varying difficulty. In Experiment 2, we extend these results by assessing whether players behaviourally act on their urge to play.

1.3 Identifying Predictors of Problematic Videogame Play: Gaming to Escape

Time spent gaming has historically been identified as a prominent risk factor of problematic gameplay, with the need to increase playing times seen as a form of tolerance within behavioural addiction frameworks (Tao, 2010; Petry et al., 2014). However, some recent evidence suggests that time spent gaming is only a weak predictor of the development and maintenance of problematic gameplay (Hellstrom, Nelssin, Leppert, & Åslund , 2012; Sanjamsai & Phukao, 2016; King, Herd, & Delfabbro, 2017; Király, Tóth, Urbán, Demetrovics, & Maraz, 2017). For example, although time spent gaming increases the risk of negative consequences, it does not necessarily guarantee that players will struggle with problematic use or negative consequences. In fact, excessive play may even have healthy, positive outcomes for some players (Griffiths, 2010).

Whether problems are a consequence of game play may depend on *why* players choose to play a game in the first place. Such motives may dictate the types of game they wish to play, and the emotional consequences they experience (Yee, 2006; Westwood & Griffiths, 2010). Players cite a variety of different reasons for gameplay, including entertainment, social interaction, challenge and excitement (Wan & Chiou, 2006; Kim & Ross, 2006). In many games, players are faced with certain challenges. Surpassing these challenges (i.e., winning or “levelling up”) trigger high states of arousal. Such arousal is a major reinforcer of playing behaviour, and players may be drawn to play to experience this pleasant form of excitement (Poels et al., 2012; Brown & Anderson, 1984). Although arousal has been shown to contribute to why a vast majority of players play (Poels et al., 2012), the motivation to play for fun or excitement in particular is not typically related to problematic video-gaming (Hellstrom et al., 2012; Kardefelt-Winther, 2014a).

A far more problematic motive for game playing involves gaming to escape. Some gamers appear to engage in game play as a maladaptive means of coping with interpersonal, psychological or emotionally negative aspects of their day-to-day lives. Unlike gaming for excitement, gaming to escape is consistently associated with problematic videogame play (Király et al., 2017; Hellstrom et al., 2012; Kardefelt-Winther, 2014a, 2014b; Petry et al., 2014). Moreover, in addition to problems related to gaming, video-game players that game to escape typically report higher symptoms of depression (Lanconi, 2017). These gamers appear to engage in game play to regulate their emotions – while gaming they find relief from the depressing mentations that characterize their day-to-day lives. Thus, gaming for these players provides a form of negative reinforcement (Baker et al., 2004). Despite these consistent associations with problematic play, there is a paucity of research that investigates exactly *how* videogames provide relief of negative affect for players.

1.4 Individual Differences in Escapism across Game Types

1.4.1 Gaming to Escape Negative Affect and Chasing Flow

A potential source of hedonic appeal for escape players could be the state of flow. Since flow is a highly enjoyable and rewarding state, it may be a key reinforcer for escape players (Csíkszentmihályi, 1990). Although flow is typically considered a productive state with positive impacts, flow researchers recognized that it can also lead to intense persistence in activities that may cause more harm than good (Csíkszentmihályi & Rathunde, 1993). Seen in this light if flow during gameplay provides escape for players looking to cope with negative mood states, it may contribute to problematic forms of game play (Chou & Ting, 2003; Schuler, 2012; Hull, Williams & Griffiths, 2013; Dixon et al., 2017; Dixon et al., 2019a; Dixon et al., 2019b; Sanjamsai & Phukao, 2019; Hu et al., 2019).

Hull, Williams and Griffiths (2013) conducted an on-line study looking at the relationship of flow, depression and problematic play. They assessed flow, levels of happiness, and problems related to video-game play in players' preferred games. They found that low levels of happiness outside of game play, time distortion within game play (a sequalae of flow) and the desire to socialize in games were strong predictors of problematic video-game play (Hull, Williams & Griffiths, 2013). Although consistent with a putative relation between flow and gaming to relieve symptoms of depression, a limitation of this study is that players recalled in-game flow experiences long after the last game session.

Dixon, Stange, Larche, Graydon and Fugelsang (2017) measured depression outside of the gaming context, and flow among players immediately after playing a session on a slot machine. They showed that those with higher depression outside of the gambling context experienced deeper flow during multi-line slots play than less depressed players (Dixon et al., 2017). They used the term "dark flow" to denote the negative consequences of being absorbed in gambling games – spending more time and money than anticipated. Importantly, this dark flow state significantly contributed to the level of positive affect that players experienced during play – thus, they argued, flow could provide the elevation of mood that depressed players may seek. In a recent study, flow accounted for positive affect variance over and above a measure of how much players experienced excitement following rewarding events in the game (Dixon et al., 2019b). These results suggest that players with symptoms of depression may be using the flow state to not only improve their mood, but also to prevent themselves from ruminating on negative thoughts (Dixon, Stange et. al, 2017; Dixon, Guitterez et al., 2019a, 2019b). By playing a challenging, attention-absorbing game, they find they have no opportunity for negative rumination.

Given the importance of flow and playing to escape in predicting problem gambling, Chapters 3 and 4 assess whether this relationship generalizes to problem video-gaming. Although there are surface similarities between the two contexts there are profound differences as well. While there is no skill at slots there is definitely skill in video games, and indeed such skill and control may be a necessary antecedent of achieving optimal flow (Fong et al., 2015). Nevertheless, it remains to be established whether the propensity to use flow to escape seen in problem gamblers also occurs in the video-gaming context. Additionally, what has yet to be empirically determined is whether players who explicitly report playing video games to escape experience *greater* flow compared to players with different motivations for game play. These are the relations we seek to address in Chapter 3 and Chapter 4 (Experiments 3 and 4).

1.4.2 Boredom and Smartphone gameplay

Despite its lucrativeness, there is a dearth of research examining how smartphone games might impact the general well-being of players. Most research focuses on general smartphone use rather than their use for gaming specifically. The little evidence available suggests that smartphone gaming may carry the potential for negative consequences in a subset of players in a way that parallels other types of gaming (Wang, 2019; Jeong, 2016; Samaha & Hawi, 2016; Gradisar, King & Short, 2017; Turel, Romanshkin, & Morrison, 2016; Turel, Serenko & Bontis, 2011). What has yet to be considered is whether the pronounced differences in the utility and structural characteristics of typical smartphone games might uniquely impact players. I address these issues in Chapter 3.

Unlike videogames that are played from a desktop computer or console, smartphone games are a more accessible and immediate form of gaming – they can be played anytime and anywhere. Such accessibility may be problematic for some players, especially if they use these games to cope with negative thoughts and feelings. Indeed, gaming to ‘escape’ noxious mood states (such as depression and anxiety) has been associated with the development of problematic technology use in general (Lin, Chiang, & Jiang, 2015; Liang & Leung, 2018; Kuss et al., 2012; Hagström & Kaldo, 2014; Kardefelt-Winther, 2014). What is less understood is whether smartphone games specifically may also be used as a form of escape.

One commonly cited reason for playing smartphone games is to “pass the time” (Lukoff et al., 2017). Consider a bus ride that is part of our daily commute. People may occasionally resort to smartphone games to alleviate boredom in such situations (Leung, 2020; Wolniewicz, Rozgonjuk, & Elhai, 2020). This type of occasional gaming is generally considered benign. However, some may find they become bored in many different contexts (termed trait boredom proneness; Farmer & Sunberg, 1986). As previously observed for general smartphone use, these boredom-prone individuals may be more vulnerable to experiencing negative consequences related to frequent smartphone gaming (Wolniewicz, Rozgonjuk, & Elhai, 2020).

At its core, boredom is an aversive state that can be triggered in situations perceived to be meaningless, monotonous, or overly difficult (Burn, 2017; Chin et al., 2016). Boredom-prone individuals experience boredom not only more frequently than others, but also may experience its accompanying negative affect more strongly. Boredom proneness is typically characterized by difficulty in engaging with the environment, and problems with sustaining attention (e.g., being prone to distraction) due to a perceived lack of environmental stimulation (Mercer-lynn, Bar, & Eastwood, 2014). The negative affect linked to boredom can range from frustration in the moment, to more chronic forms of negative affect such as depression (Chin et al., 2016). Like depression, boredom proneness is also characterized by ruminative thoughts – however, these ruminations tend to relate to the need for something to do (Danckert, 2019; Elhai, Vasquez, Lustgarten, Levine, & Hall, 2018). Thus, smartphone games may provide these boredom-prone players with an easy and immediate route to sustainable, effortless attention and engagement that they otherwise lack. Importantly, if players frequently resort to smartphone gaming to stave-off boredom, problems related to gameplay may surface (Chou & Ting, 2003; Roberts, Yaya, & Manolis, 2014).

Like those who game to escape negative affect and thoughts associated with depression, flow is an integral aspect of gaming that might appeal to the idle minds of boredom-prone individuals is the experience. The heightened positive affect tied to the experience of flow during gameplay may cause a subset of players to resort to gaming to escape the aversive thoughts and feelings they experience during their frequent episodes of boredom.

As mentioned, for boredom-prone individuals, the aversive thoughts and feelings appear to trigger the need to act. Certain actions may be preferred above others. If bored individuals suffer from insufficient stimulation during their everyday tasks, they may seek actions that increase arousal (Struk, 2019; Mercer-lynn, Bar, & Eastwood, 2014; Burn, 2017). Since flow states are associated with elevated arousal (Peifer et al., 2014; Drachen et al., 2010) and smartphone games can induce flow, boredom prone people may be particularly drawn to such games.

As mentioned, a key component in gaming to escape involves the positive affect experienced while gaming. However, given the strong positive correlation between flow and positive affect during gambling scenarios (e.g., Dixon, Gutierez et al., 2019b) one might expect that those seeking relief from boredom may also experience more pronounced positive affect during optimally challenging, flow inducing games. Taken together, In Chapter 3, we hypothesized that if playing games induces flow, arousal and positive affect this may provide a triad of experiences that bored individuals might use to quell their boredom. If so then we might expect greater flow, arousal, positive affect, and urge-to-play among this group. Such a pattern of results may be interpreted as resulting from a contrast effect. In their day-to-day lives these habitually bored individuals experience minimal, flow arousal and positive affect. When gaming they find they experience moderate flow, arousal and positive affect. Because these states are so unusual for them, they may endorse experiencing deeper flow, more arousal and more positive affect than non-escape gamers.

1.4.3 The Role of Game Genre in Inducing Flow: The case of Role-Playing Games

Video games may be an ideal medium for inducing flow because the level of difficulty adjusts to the player's skill in order to maintain a balance between challenge and skill that is known to promote flow. Some games, however may be more conducive to flow than others. Indeed, certain genres of games may facilitate more enriched, profound experiences of immersion. Johnson et al., (2012) examined flow experiences across different game genres and found that Role-Playing/Strategy and Action-Adventure games were associated with enhanced flow and immersion compared to sport, racing or fighting games. Furthermore, escapism as a motive is commonly cited among players of multiplayer online Role-Playing strategy games like *World of Warcraft* (Dauriat et al., 2011; Hilgard et al., 2013), and players who primarily play role-playing games have higher scores on disordered gaming scales (Eichenbaum, Kattner, Bradford, Gentile, & Green, 2015; Kim et al., 2010; Na et al., 2017). Escape gamers may be more common in RPGs due to the immersive properties that these types of games possess. As mentioned, RPGs tend to feature extensive world building (e.g., narratives and storylines), as well as developed characters - details that allow players to feel fully immersed and separated from reality. Our goal was to explore whether game genre has an impact on the depth of flow for all players, and for escape gamers more specifically.

Taking an in-vivo approach similar to Dixon et al. (2017, 2019a, 2019b), in Chapter 4 (Experiment 3 and 4) we sought to examine whether players who indicate that they game to escape exhibit different experiences of flow, positive affect and arousal during a Role-playing Game than those who game solely for excitement. If flow provides relief to those who game to cope – and RPG games are designed to induce flow in such players, not only should escape gamers experience greater flow while playing an RPG game, they may also experience greater positive affect while playing these games.

In sum, the experiments below present a systematic program of research that seeks to show how flow plays a role in negative consequences related to videogaming, particularly among those who game for maladaptive reasons (e.g., coping with negative affect). These experiments highlight the significance of structural characteristics in the facilitation of flow, as well as how structural characteristics can also be used to mitigate the harmful effects of flow.

Chapter 2: Measuring Flow via the Skill-Challenge Balance in A Smartphone Game

2.1 Experiment 1[2]

2.1.1 Research Questions & Hypotheses

Experiment 1 has three aims. First, we aim to assess the relationship between the skill-challenge balance and flow when the skill-challenge balance is perturbed by game complexity rather than speed. The skill-challenge balance will be determined using an absolute difference score between perceived challenge and perceived skill. High scores emerging from this subtraction would be obtained when games are too easy or too hard, whereas low scores would accrue when there is a balance of skill and challenge. Here we seek to show that flow would be maximally induced by players attempting to play games at their current level standing (i.e., a balance of challenge and skill) whereas flow would be reduced when playing games that were either too hard or too easy. Games that are too easy are expected to be the most boring and least frustrating, while games that are too hard, should be the least boring yet most frustrating. Second, we seek to compare the classic and quadrant models of flow using players' subjective reports of skill, challenge and flow during gameplay. We expect to show that a game like Candy-Crush will more strongly support a quadrant model of flow (see Figure 1.1, panel B) in which the greatest flow would be experienced by those whose high perceived skill is balanced by high perceived challenge in the game (e.g., those falling into the hypothetical "flow" quadrant of the

[2] Major parts of this chapter are taken directly from Larche and Dixon (2020).
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model), more so than those whose lower perceived skill is balanced by lower levels of challenge (e.g., those falling into the apathy quadrant of the model). Third, we will examine whether the degree to which flow was experienced impacts the player's urge to continue playing.

2.1.2 Methods

Participants

A total of 72 participants were recruited from a pool of psychology students at the University of Waterloo. Eligible participants were those who: reached at least level 70 in the Candy-Crush Saga and had played within the last 12 months. Assigning a cut-off of level 70 in the Candy-Crush Saga ensured that the researchers could create a too-easy condition – a situation that would not be possible had we used more novice players. Level standings ranged from 77 to 828 in our sample.

The study's protocol was reviewed and approved by the University of Waterloo Research Ethics Committee. Consenting participants were advised that they could withdraw at any point in the study without penalty.

Apparatus

Lenovo Tablets. Two Lenovo Tab 10" tablets were used - one for gameplay and one to administer surveys using Qualtrics software.

Candy-Crush Saga Game. Participants played a real version of the Candy-Crush Saga on a Lenovo Tablet device. The tablet device was mounted onto an inclined platform, facing a Logitech camera (1080 HDMI) that recorded the games.

Materials

Pre-test Questionnaire. The pre-test questionnaire assessed demographic information (e.g., age, gender) and their general mobile gaming behaviour (e.g., frequency of play).

Subjective Arousal. Participants were asked to indicate their level of subjective arousal by pointing to a Self-Assessment Manikin (SAM; Lang, 1985) that best matched their in-game arousal level (see Figure 2.1).

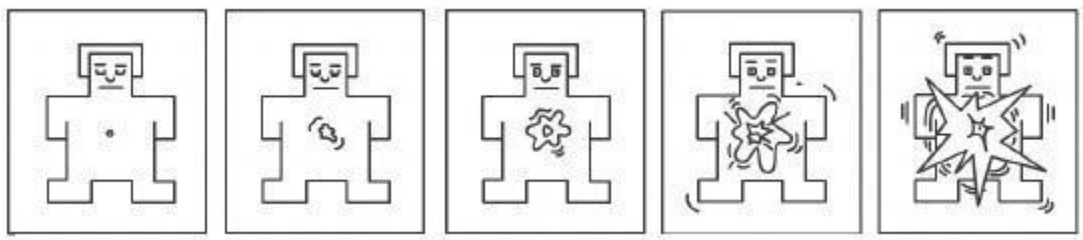

Figure 2.1 Self-assessment manikins (SAMs) indexing subjective arousal from low arousal on the left, to high arousal on the right.

Urge-to-play. Two items were used to measure player urge (previously adapted from the Gambling Urge Scale; see Larche, Musielak & Dixon, 2017). Participants responded to "All I want to do is keep playing" and "I want to play so badly that I can almost feel it" using a 7-point Likert scale, with 1 indicating *'Strongly Disagree'* and 7 indicating *'Strongly Agree'*. The two items were summed. For multiple games of the same type (e.g., two easy games) these summed scores were averaged for each game condition.

Game Experience Questionnaire. The in-game module of the Game Experience Questionnaire (GEQ; IJsselsteijn, De Kort, & Poels, K., 2013) was used to assess flow, perceived skill, perceived challenge and boredom during gameplay.

For flow, participants responded to the statements “I forgot everything around me” and “I felt completely absorbed”. For skill, participants responded to the two items “I felt skilful” and “I felt successful”. For challenge, participants responded to the two items “I felt challenged” and “I had put a lot of effort into it”. Finally, for boredom participants responded to the single negative affect subscale item “I felt bored”.

All items on the GEQ were answered on a 5-point scale, with 0 indicating *‘not at all’* and 4 indicating *‘extremely’*. Items for each construct (flow, challenge, skill and boredom) were summed then averaged (for games of the same type).

Skill-Challenge Balance. The skill challenge balance was defined as the absolute difference between perceived challenge ratings and perceived skill ratings respectively for each game (e.g. Skill-Challenge Balance = |Challenge – Skill|).

Frustration. Subjective frustration was measured by having participants evaluate how much they agree/disagree with the statement “I feel frustrated” on a 7-point Likert scale.

Design and Skill-Challenge Balance Manipulation

Participants played two very easy games, four regular games, and two very hard games (eight games total). Regular games consisted of games that were near their current level standing (within a ten-level interval above or below the participant’s current level standing). Hard games, were 100 levels above the participant’s current level standing and would contain some features unfamiliar to players. Easy games involved levels at the very beginning (i.e., any level under level 10 in the game typically contains goals that can be easily reached).

Games were separated into two blocks of four games (an easy, two regular and a hard game in each block) with the games within blocks counterbalanced.

Procedure

Participants' consent was obtained and their current level standing verified. Participants played two practice games to familiarize themselves with the procedure and with the post-game surveys administered at the end of each game (e.g., including questions of boredom, flow, skill, challenge, and positive affect), arousal, frustration and urge-to-play. Participants then played the first block, followed by a second block of games (45 minutes of gameplay).

Data Analysis Strategy

Average scores for each dependent variable (e.g., boredom, frustration, arousal, skill, challenge, skill-challenge balance, flow, and urge) were calculated for each game type (easy, regular games and hard games) for each block of games. Since there were no statistical differences between block 1 and block 2 for each game type, ($ps > .05$ for all measures) a single average for easy games, regular games and hard games was calculated for each participant.

Data points falling 3 SD above or below the mean were considered outliers and removed. Normality was assessed for each measure using Kurtosis Fisher coefficients. Kurtosis statistics for each of our dependent variables fell within acceptable cut-off ranges (e.g., -2 and + 2; see Gravetter & Wallnau, 2014) allowing parametric statistics for analysis.

A series of one-way Repeated Measures ANOVAs assessed the influence of game type for each of the measures. Where violations of sphericity occurred Greenhouse Geisser corrections were applied to the degrees of freedom. Fisher's LSD post-hoc comparisons were used to compare easy, balanced and too hard games in the event of significant main effects.

2.1.3 Results

Out of the 72 participants recruited, 12 had to be removed due to a failure of the difficulty manipulation. Specifically, we eliminated those who won a game that was supposed to be too hard, or lost an easy game. For the remaining 60 participants, their performance in the extreme games conformed to the difficulty manipulation – they all lost the games that were supposed to be too hard, and won the games designed to be too easy. For the regular condition, games were averaged regardless of whether they won or lost. Games at a player's level standing were assumed to be designed to compensate for skill level by presenting players with games whose complexity would be slightly greater than their skill level. Such a design strategy would not only ensure a balance between skill and challenge, but also create a variable-ratio reinforcement schedule, with winning outcomes being relatively infrequent and most importantly unpredictable. On average, players won only 1.12 games out of the 4 regular games they played.

We first looked at the experience of boredom, and frustration across each game difficulty condition to confirm whether these experiences conformed to the expected states hypothesized by both the classic models and the quadrant model (see Figure 1.1, panels A and B where the "anxiety" area is instead denoted by "frustration"). We also measured arousal which previous research suggested might be high in both the regular game (due to excitement) and the too-hard game (due to frustration). Participants average experiences of boredom, frustration and arousal are shown in panels A, B and C of Figure 2.2. Boredom scores statistically differed across the three levels of difficulty, $F(1.44, 85.02) = 12.63$, $p<.001$, $\eta_p^2 = .176$. Post-hoc comparisons showed that players felt the most bored while playing the easy games (M = .99, SD = .89), and were less bored during the regular games (M = .64, SD = .59) and the hard games (M = .58, SD = .70); boredom was significantly higher for the easy versus balanced, and easy versus too hard (both ps <.001). There were no differences in boredom between the regular and hard games (p = .105).

Frustration statistically differed across the three levels of difficulty, $F(2,118) = 134.57$, $\eta_p^2 = .695$, $p < .001$. Post-hoc comparisons revealed players to be least frustrated during an easy game (M = 1.73, SD = .927), slightly more frustrated during the regular games (M = 3.65, SD = 1.26), and the most frustrated while playing a hard game (M = 4.27, SD = 1.37; the three conditions all differed from one another all ps <.001).

For arousal there was a significant main effect of difficulty level, $F(1.50, 89.04) = 15.62$, $p < .001$, $\eta_p^2 = .209$. Post-hoc comparisons indicated that the easy games (M = 2.40, SD = .98; induced lower arousal than the regular or hard games, (both ps <.001). The regular (M = 2.85, SD = .68) and hard games (M = 2.98, SD = .88) did not differ (p = .108).

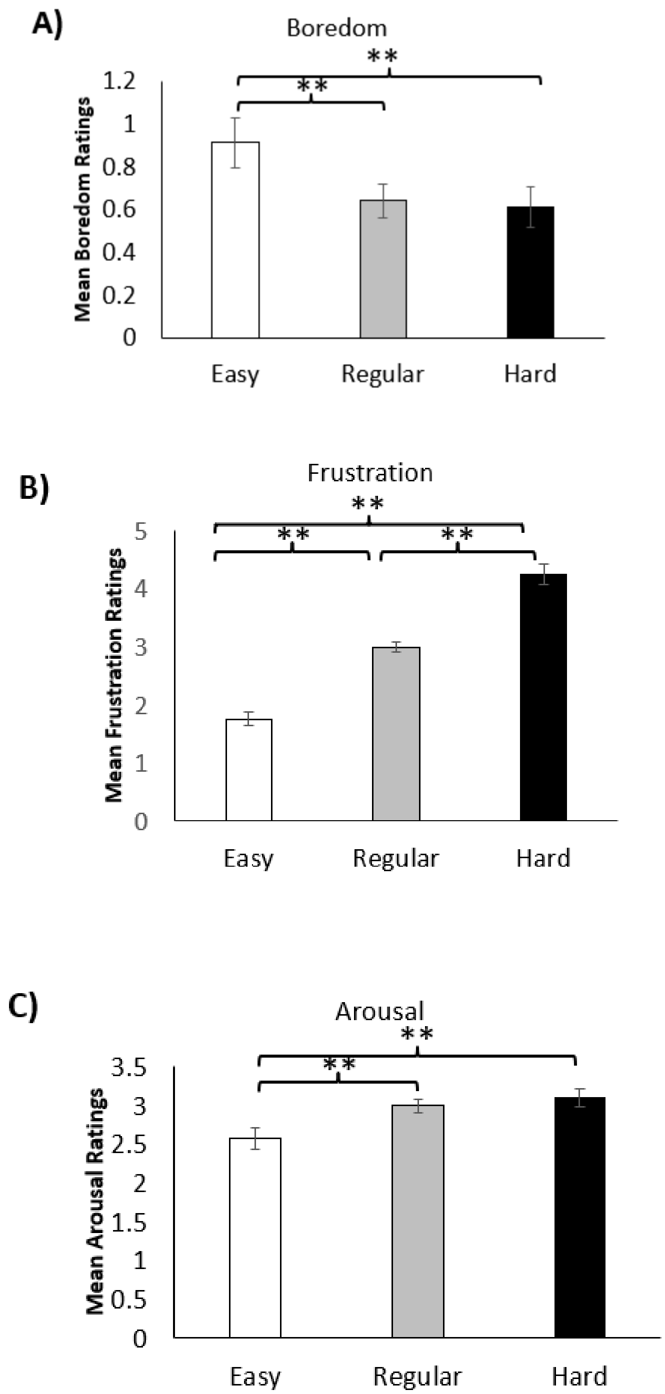

Figure 2.2 Average **A)** boredom, **B)** frustration and **C)** arousal scores across the three levels of difficulty. Error bars ±1 SE. $^{**}p < .01$, $^{*}p < .05$.

Perceived Skill, Challenge, and the Skill-Challenge Balance

As a manipulation check confirming that our difficulty manipulation was capable of perturbing the skill-challenge balance, we assessed subjective ratings of challenge, skill, and balance respectively. Panels A and B of Figure 2.3 show the means for skill and challenge across each level of difficulty. There was a significant main effect of skill, $F(1.41, 83.54) = 55.53$, $p < .001$, $\eta_p^2 = .485$. Post-hoc comparisons indicated that players felt the most skilled while playing the easy games ($M = 2.18$, $SD = 1.21$), slightly less skilled during the regular games ($M = 1.39$, $SD = .74$), and the least skilled during the hard games ($M = .96$, $SD = .78$; all *p*s <.001; See Panel A of Figure 2.3). For challenge scores there was a significant main effect of difficulty, $F(1.40, 81.72) = 164.15$, $p < .001$, $\eta_p^2 = .739$. Post-hoc comparisons showed that players felt the easy games were the least challenging ($M = .66$, $SD = .81$), the regular games slightly more challenging ($M = 2.18$, $SD = .75$), and the hard games were the most challenging ($M = 2.44$, $SD = .911$; all *p*s <.001; see Panel B of Figure 2.3).

Our metric of skill-challenge balance was calculated as the absolute difference of participants' respective skill and challenge ratings (shown in Figure 2.3 panel C). Using this metric there was a significant main effect of balance, $F(1.71, 101.14) = 11.57$, $p < .001$, $\eta_p^2 = .164$. That is, players felt little balance when playing the easy games ($M = 1.47$, $SD = 1.16$), and significantly more balance playing the regular games ($M = .91$, $SD = .60$; $p < .001$) and significantly less balance playing the hard games ($M = 1.54$, $SD = .82$; $p < .001$). Balance for the hard and easy games did not statistically differ ($p = .684$).

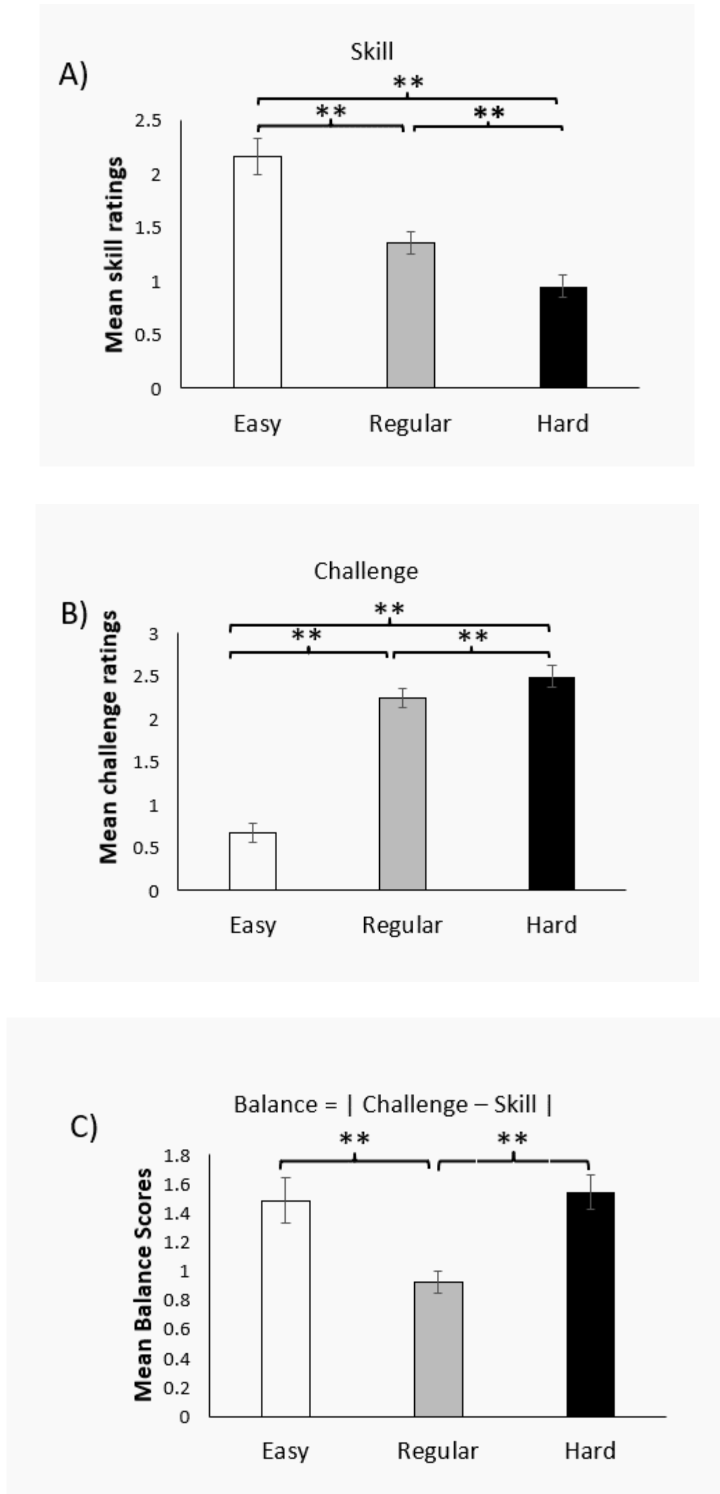

Figure 2.3 A) Subjective reports of skill across each game difficulty condition, B) Subjective reports of challenge across each game difficulty condition, C) the perception of balance,

calculated as the absolute difference between subjective skill and challenge scores, with lower scores indicating greater balance. Error bars ±1 SE. **$p < .01$, * $p < .05$.

Skill Challenge Balance and Flow

As shown in Figure 2.4, our measures of flow depended on the difficulty of the game played. Specifically there was main effect of game difficulty, $F(1.65, 97.37) = 5.82$, $p = .007$, $\eta_p^2 = .09$. Post-hoc comparisons revealed that players experienced less flow for the easy games (M = 2.62, SD = 1.11) compared to the regular games (M = 2.83, SD = 1.06; $p < .001$) and the hard games (M = 2.83, SD = 1.10; $p = .014$). Intriguingly, regular and hard games were equally flow inducing ($p = .922$), even though players felt the harder games were too challenging for their level of skill (i.e., an imbalance of challenge and skill). Such results deviate from previous research which manipulated challenge via speed of play. It suggests that for games whose difficulty depends on complexity, games that are too easy will induce minimal flow, but even games that should be far too difficult can still induce as much flow as games in which the skill challenge balance is optimized.

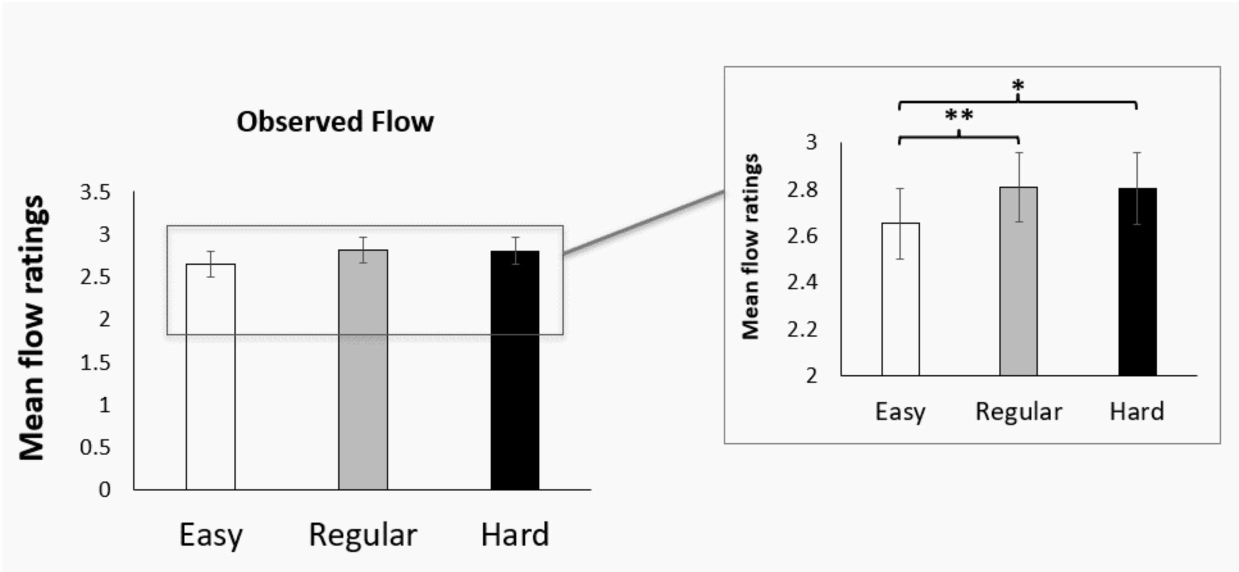

Figure 2.4 Observed levels of flow across game difficulty conditions based on complexity (with subpanel highlighting effects with refined axis). Error bars ±1 SE. **p < .01, * p < .05.

An axiom in game design is that as players get better the designers compensate by making the game harder (i.e., they maintain the skill-challenge balance). This can be demonstrated by assessing the correlation between perceived skill and challenge for games near their current play level (i.e., the regular games). Specifically, if game designers did not adjust challenge to meet players skill then there would be no correlation between challenge and skill – however, if they compensated for increasing skill by increasing challenge then a significant correlation would be expected. Figure 2.5 shows a scatterplot of players' average ratings of skill and challenge following these regular games as well as a theoretical (orange) line depicting an exact match of challenge and skill as well as the (dashed) line of best fit for the obtained data. There was a significant correlation between skill and challenge for the regular games, $r(58) = .478$, $p < .001$. As shown in the figure most data points fall below the theoretical line. This reflects developers compensating for a players' high skill by making the game slightly harder than their skill level (recall players won only approximately every 4^{th} game). This makes sense when one considers how outside of the laboratory players achieved their current level. They may have played 3 or 4 games and lost them all, then levelled u*p* on the 5th game. If the game difficulty increases with the new level achieved, it would maintain a situation where challenge slightly, but consistently, exceeds skill.

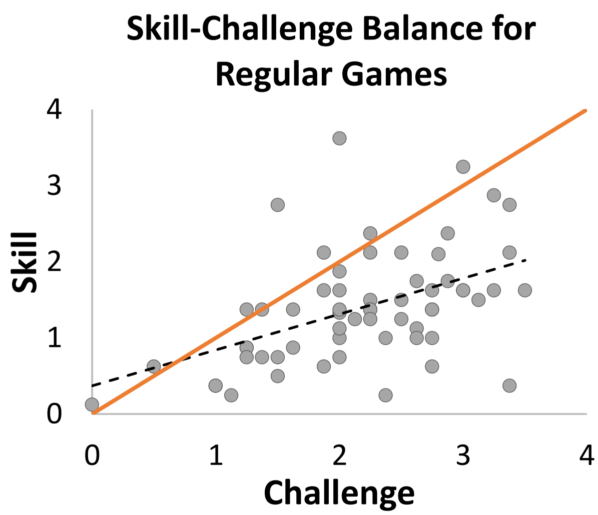

Figure 2.5 Scatterplots depicting the relation between skill and challenge for all participants for the regular games. Orange line indicates the theoretical slope of 1 indexing a skill-challenge balance.

To assess whether flow in Candy-Crush adhered more to the quadrant model of flow than the classic model we separated participants into the upper and lower quartiles of flow. Here we analyzed only the regular games since they induced both greater skill-challenge balance and flow. Table 2.1 displays the means and standard deviations of the upper and lower quartiles of flow for these games, $t(28) = -16.33$, $p < .001$.

Table 2.1 *Means of Upper and Lower Flow Quartiles for Regular Games*

	Regular Games		
	n	Flow	SD
Lower Quartile	15	.488	.33
Upper Quartile	15	3.16	.50

Figure 2.6 displays scatterplots representing skill, challenge. The white dots represent those in the lower quartile of flow scores, black dots those in the upper quartile.

In Figure 2.6, the theoretical slope for a perfect 1:1 ratio of skill and challenge scores is displayed for reference. This line reflects a perfect match of challenge and skill, where we would expect the highest flow scores to emerge in the classic model. For the regular game, one can see four scores falling directly on, or adjacent to (touching) this theoretical line – all four of these participants were in the *lower* quartile of flow scores. Hence, the classic model does not appear to adequately capture flow induction as predicted by the perfect matching of challenge and skill.

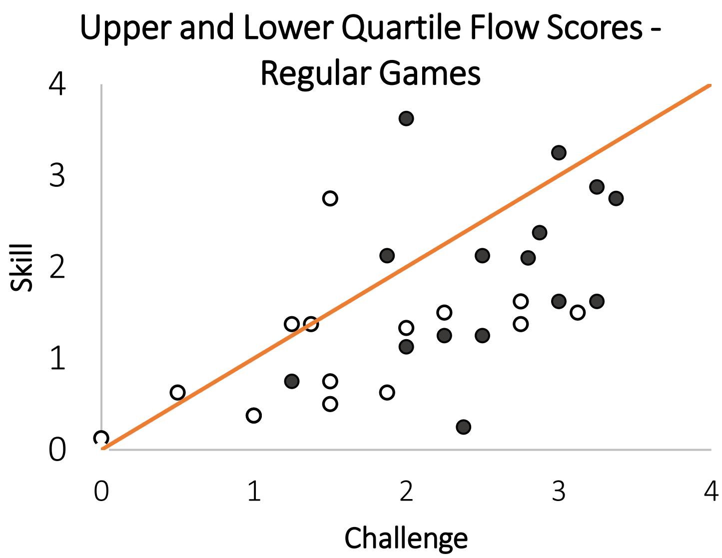

Figure 2.6 Scatterplot representing the skill-challenge balance for the upper and lower quartiles of flow experienced during the regular games. White dots represent the lower quartile of flow scores while black dots represent the upper quartile of flow scores. Orange line indicates the theoretical slope of 1 indexing a skill-challenge balance.

In Figure 2.6 one also sees the ramification of increasing the difficulty of the game – the majority of points fall below the theoretical line depicting a perfect balance of skill and challenge. Figure 2.7 also shows the upper and lower quartile scorers for the regular games but in this figure we have drawn the key quadrants pertaining to the quadrant model (the "apathy" quadrant in the lower left, and the "flow" quadrant in the upper right). Visually one can see that far more high flow scores fall into the high-skill and high-challenge quadrant for the regular games condition (6 out of the 15 upper quartile scores, versus zero out of 15 lower quartile scores).[3] By contrast, the majority of low flow scores fall into the low skill and low challenge quadrant of the graph (8 out of 15 lower quartile scores), with only 1 high flow score in this quadrant. A chi-square test of independence confirmed that whether a player experienced high or low flow in the regular games depended on which of the two key quadrants players landed. Players in the upper quartile of flow were significantly more likely to be in the upper quadrant and players in the lower quartile of flow were significantly more likely to be in the lower quadrant, χ^2 (1) = 10.81, $p < .05$.

[3] For this particular analysis we only considered scores that were unambiguously falling into the key quadrants of interest (e.g., flow and apathy).

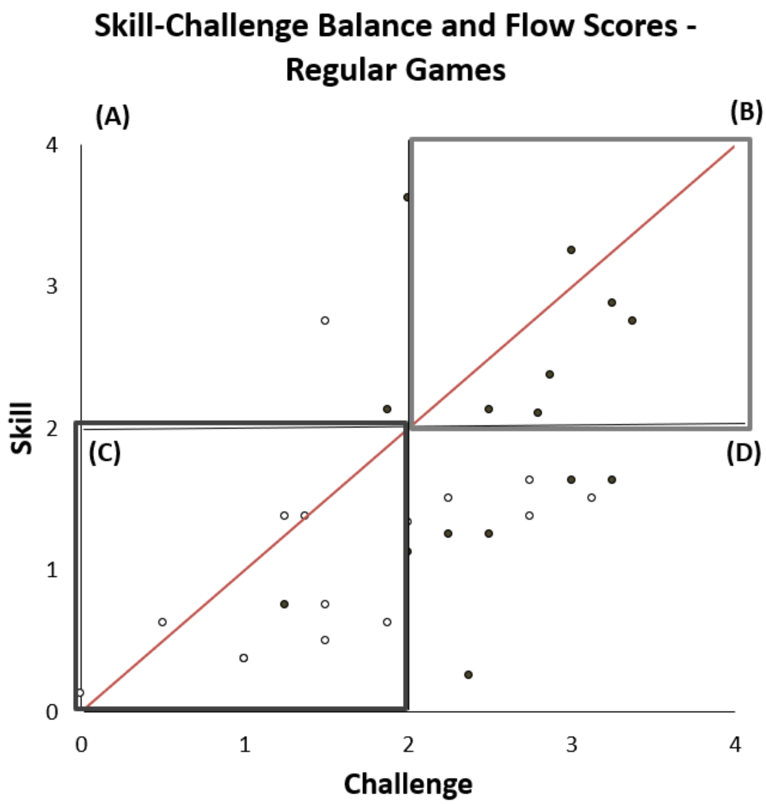

Figure 2.7 Scatterplot depicting the relation between skill, challenge and flow, highlighting the lower quartile (white dots) and upper quartile (black dots) of flow scores for the regular games. In assessing the "quadrant model" of flow, the grey box on the graph indicates the high skill and high challenge quadrant containing the preponderance of high flow scores, while the black box indicates the preponderance of low flow scores in the low skill and low challenge quadrant. Red line represents theoretical slope of 1 indexing the skill-challenge balance.

One problem with the above quadrant analysis is that players in the regular game playing near their current level, will likely find that challenge will be slightly higher than their skill level for most of the games that they play. This causes problems in determining exactly where the "quadrants" should lie. According to the quadrant model, however, the general principle is that those with higher perceived challenge and skill will be more likely to experience flow than those with lower perceived challenge and skill. If so, then those in the upper quartile of flow should have significantly higher challenge, and significantly higher skill scores than those in the lower quartile of flow scores. Also, if one were to combine challenge and skill scores into a single metric (challenge plus skill scores) those in the upper quartile of flow scores should have higher combined scores than those in the lower quartile. Table 2.2 shows that these contentions are all statistically true for the regular games.

Table 2.2 *Independent t-tests for the means (and standard deviations) of skill, challenge, and the means of skill + challenge between those in the upper and lower quartiles of flow for the regular games*

	n	Challenge	SD	t	p-value
Lower Quartile of Flow	15	1.62	.85	-3.42	p = .002
Upper Quartile of Flow	15	2.55	.60		
	n	Skill	SD	t	p-value
Lower Quartile of Flow	15	1.08	.68	-2.85	p = .008
Upper Quartile of Flow	15	1.94	.94		
	n	Challenge + Skill	SD	t	p-value
Lower Quartile of Flow	15	2.70	1.35	-3.67	p < .001
Upper Quartile of Flow	15	4.49	1.30		

N.B. p-values are statistically significant at a = .05.

The same relation between absolute levels of challenge, skill and flow holds when considering the entire sample. For the regular games the combined scores (challenge plus skill) are significantly positively correlated with flow scores, $r(58) = .597$, $p<.001$.

Flow Experiences and the Urge-to-play

Figure 2.8 depicts the mean urge-to-play ratings across the different levels of difficulty. A repeated measures ANOVA revealed a significant main effect of difficulty on the urge to play, $F(1.63, 96.71) = 11.46$, $p < .001$, $\eta_p^2 = .163$. Post-hoc comparisons revealed significantly less urge induced by the easy games (*M* = 6.84, *SD* = 3.08) compared to the regular games (*M* = 7.58, *SD* = 2.94; *p* < .001) and the hard games (*M* = 7.70, *SD* = 3.13; *p* < .001). Similar to our results for arousal and flow, while easy games were minimally urge inducing, regular and hard games were equally effective in inducing the urge to continue playing (*p* = .413).

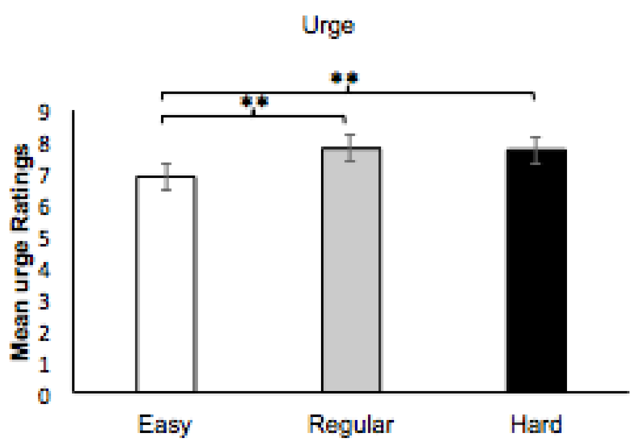

Figure 2.8 Average urge ratings across the three levels of difficulty. Error bars ±1 SE. **p < .01, * p < .05.

Our converging patterns of arousal and flow make it difficult to tease apart whether flow has a unique influence on urge, over and above arousal (which is known to influence urge in Candy-Crush; see Larche, Musielak, & Dixon, 2017). To address this, we used hierarchical regression to determine the extent to which flow drives urge independent of changes in arousal. We restricted our analyses to the regular and hard games condition since both flow and urge were substantially greater in these conditions. Since the relationship between arousal and urge is well established in the gaming literature, arousal was therefore entered at Step 1 of our model predicting urge. Flow was then entered at Step 2 of the model. At Step 1, arousal accounted for 44.2% of unique urge variance, $F(1, 58) = 45.86$, $p < .001$. Flow then accounted for an additional 21.8% of unique urge variance over and above arousal, $R^2 = .660$, *F-change* $(1, 57) = 36.69$, $p < .001$. Similarly for the hard games, at Step 1 arousal accounted for 46.5% unique urge variance, $F(1, 58) = 50.46$, $p < .001$. At Step 2 flow accounted for an additional 20.2% unique urge variance over and above arousal, $R^2 = .667$, *F-change* $(1, 57) = 34.4$, $p < .001$.

2.1.4 Discussion

Experiment 1 assessed the relationship between the skill-challenge balance and flow in a mobile video-game as well as the affective consequences that accompany flow (e.g., boredom, frustration and arousal). As in previous research we perturbed the skill-challenge balance by manipulating difficulty. In Candy-Crush, however, game difficulty was manipulated by the complexity of the moves required to solve the puzzle rather than the speed manipulations that have been used in previous research. We also compared two models of flow, namely the classic channel model and the quadrant model of flow – each carrying very different implications of optimal flow for players of different perceived skill levels. We demonstrated that those with low perceived skill experienced low flow even if there was an exact match between their low perceived skill and low perceived challenge – a data pattern that contradicts the classic channel model. Conclusively we showed that those with high perceived skill experienced greater flow than those with low perceived skill – a data pattern consistent with the quadrant model. We also show that flow is uniquely and highly motivating in an authentic game setting.

Levels of boredom and frustration across the games with different levels of difficulty mirrored predictions of the classic and quadrant models of flow. Easy games were the most boring as players were able to level up with ease. As difficulty increased games became less boring, such that the regular and hard games were less boring than the easy games. Interestingly, scores for boredom were relatively low across all levels of difficulty (scores less than 1), attesting to the appealing nature of Candy-Crush as a game in general. Harder games were also the most frustrating as players could not reach the game's objectives, with regular games being less frustrating, and the easy games the least frustrating. Because players were playing on a designated device rather than their own, we would perhaps expect these frustration scores to be amplified in more naturalistic settings.

Our skill-challenge balance manipulation using difficulty manipulations in Candy-Crush successfully replicated what has been previously observed by past research (Baumann et al., 2016; Engeser & Reinberg, 2008; Keller & Bless, 2011; Keller et al., 2011a, b; Kennedy et al. 2014; Tozman et al., 2017; Vuorre & Metcalfe, 2016). Players felt the most balanced when playing games around their level standing, and the least balanced when playing levels that were too easy (i.e., skill far outweighing challenges in the game) or levels that were far too hard (i.e., challenges far outweighing skill).

Despite successfully perturbing the balance of challenge and skill our results only partially reflected the inverted-U shape pattern of flow shown in previous research. Consistent with prior research players experienced the least flow during the very easy games, and substantially more flow during the regular games by comparison. However, the hard games triggered comparable flow to the regular games, suggesting that players were not overwhelmed by the higher challenge. Reasons for this will be discussed in the general discussion.

Crucially, in line with hypotheses facilitated by Keller, Ringelhan and Blomann (2011), players reported higher urge-to-play following the regular and hard games, where flow was experienced, and relatively less urge-to-play following the easy games where flow was curtailed. The hierarchical regression demonstrated that flow accounted for unique urge variance over and above arousal - a primary reinforcer of gaming behavior (Brown & Anderson, 1984; Poels et al., 2012). Combined with our quadrant analysis, the increased flow observed among those with higher perceived skill suggests these players are at a higher risk for problems given the enjoyable and motivating state of flow (Wu et al., 2013; Kubey & Csikszentmihalyi, 2002. In order to verify if this is indeed the case one would need to measure potential for problems using a validated scale of problematic gaming.

2.2 Experiment 2[4]

2.2.1 Research Questions and Hypotheses

Experiment 1 showed that more balanced games led to not only increases in arousal and flow but also in the urge to keep playing. That is, the more deeply players experienced flow the greater their urge-to-play ratings. Experiment 1 also showed using hierarchical regression that flow accounted for unique urge variance over and above arousal. Yet, this study still does not tell us how players may behaviourally act on their urge. As a next step Experiment 2 sought to provide converging evidence for the motivational effects of flow by having players actively choose which games they wish to re-engage in, mirroring the paradigm presented in Keller et al. (2011).

To summarize, the first aim of Experiment 2 was to replicate the findings of Experiment 1 concerning flow, arousal, boredom and urge in too easy versus more balanced games. We also sought to extend these findings by showing that balanced games resulted not only in less boredom, and greater flow and arousal, but also more positive affect than games that were too easy. This is of crucial importance since if we can show that flow-inducing games increase positive affect, it sets up the possibility that such games may be particularly alluring to those who seek to escape the negative affect associated with boredom. Showing higher positive affect while playing balanced games would also show that positive affect is not all about whether you win or not, but the circumstances that led to the win. If winning a challenging game leads to greater positive affect than winning a very easy game, it suggests that flow may play a role in

[4] Major parts of this chapter are taken directly from Larche and Dixon (2021).

determining that positive affect. Finally, we sought to extended the findings of Experiment 1, by showing that not only do balanced games trigger greater urge-to-play compared to easy games, but also that players would actively choose to play these optimally challenging games more so than the too-easy games.

2.2.2 Methods

Participants

A total of 60 psychology undergraduate students were recruited. To be eligible for participation, participants must: 1) Have played up to at least level 70 in the Candy Crush Saga, and (2) have played Candy Crush Saga within the last 12 months.

The current study's protocol was reviewed and approved by the University of Waterloo Research Ethics Committee. All participants were provided sufficient information about the study prior to participating, and were advised that they could withdraw at any point in the study without penalty.

Apparatus

Lenovo Tablets. Two Lenovo Tab 10" tablet devices were used: one for gameplay, the other for participants to respond to survey questions.

Candy Crush Saga Game. Participants played a real version of the Candy Crush Saga. The tablet was mounted onto an inclined platform, along with a logitech camera (1080 HDMI) positioned to record the game.

Materials

Demographics. Demographic information (e.g., age, gender, average playing frequency within a week) was measured at the beginning of the session.

Subjective Arousal, Flow, Skill, Challenge, Boredom, Skill-Challenge Balance and Urge. Measures of Subjective Arousal, Flow, Skill, Challenge, Boredom, Skill-Challenge Balance and Urge were identical to Experiment 1.

Positive Affect. Positive affect was assessed with the positive affect subscale of the in-game module of the Game Experience Questionnaire (GEQ; IJsselsteijn, De Kort, & Poels, K., 2013). Players responded to the statements "I felt content" and "I felt good" were on a 5-point Likert scale, with 0 indicating *'not at all'* and 4 indicating *'extremely'*.

Preference. Following the end of all game play the researcher presented the participant with two levels on which to continue gameplay: one easy level, and one "balanced" level. The researcher recorded the participant's selection as "easy" or "balanced" in the online survey.

Design and Skill-Challenge Balance Manipulation

Participants played a series of eight games: four balanced games and four "too easy" games interspersed over the playing period. Balanced games consisted of games that were near their current level standing (within a ten-level interval above or below the participant's current level standing). The "too easy" games were selected from levels (1-10) at the very beginning of the game, which contain goals that can easily be reached for players that met our level-70 entrance criterion. To facilitate counterbalancing, the order of easy and balanced games, games were separated into two blocks of four games. Each block consisted of two balanced and two easy games. To measure player preference, after playing the eighth game participants were given the choice to continue playing an easy game or a balanced game. To ensure that players choices were not enticed by the chance to improve their current level standing, for the balanced game, they were offered the chance to play only games 1-10 levels *below* their current level standing. Thus, they could play either very easy games, or games near their current level, but with no chance of them obtaining a "personal best".

Procedure

Participants first completed a consent form and verified their current level standing in the game which determined the levels participants would play for the balanced games (current level + or – 10 levels). Easy games were from levels 1 to 10.

Participants played two practice games to familiarize themselves with the procedure and the post-game surveys administered at the end of each game (e.g., including questions of skill, challenge, flow, arousal, positive affect boredom, and urge-to-play). Participants then played the first block, followed by a second block of games, totalling approximately 45 minutes of gameplay.

Following the eight games, the researcher presented the participant with two possible levels in which to continue gameplay. Participants were instructed that they could stop playing at any time once they selected their level.

2.2.3 Results

The total sample of 60 participants (53 female, 7 male) was included in our analyses. Participant level standings ranged from 77-3307.

Perceived Skill, Challenge, Skill-Challenge Balance, Flow and Arousal

Firstly, we performed a manipulation check by assessing players perceived skill, challenge and skill-challenge balance to ensure that our easy and balanced games did indeed differ in terms of the skill-challenge balance. In line with past findings, players felt less challenged by the easy games compared to the balanced games, $t(59) = -11.76$, $p <.001$, $d = 1.71$ (Panel A of Figure 2.9). Additionally, players felt more skillful when playing the easy games compared to playing the balanced games in Candy Crush, $t(59) = 7.81$, $p < .001$, $d = 1.09$ (Panel B of Figure 2.9). When comparing the absolute value of challenge minus skill ratings (see Experiment 1) players felt significantly less balanced during the easy games than the balanced playing games, $t(59) = 2.37$, $p = .021$, $d = .445$. (Panel C of Figure 2.9).

For flow we found that the easy games were less inducing of flow than the balanced games, $t(59) = 2.96$, $p = .004$, $d = .218$ (Panel D of Figure 2.9). Players also experienced more arousal for the balanced games compared to the easy games, $t(59) = 5.81$, $p < .001$, $d = .621$ (Panel E of Figure 2.9). Overall, our findings suggest that when playing around their level standing players feel adequately challenged relative to their skillset, and in turn experienced greater flow and arousal for these games compared to playing games that were too easy.

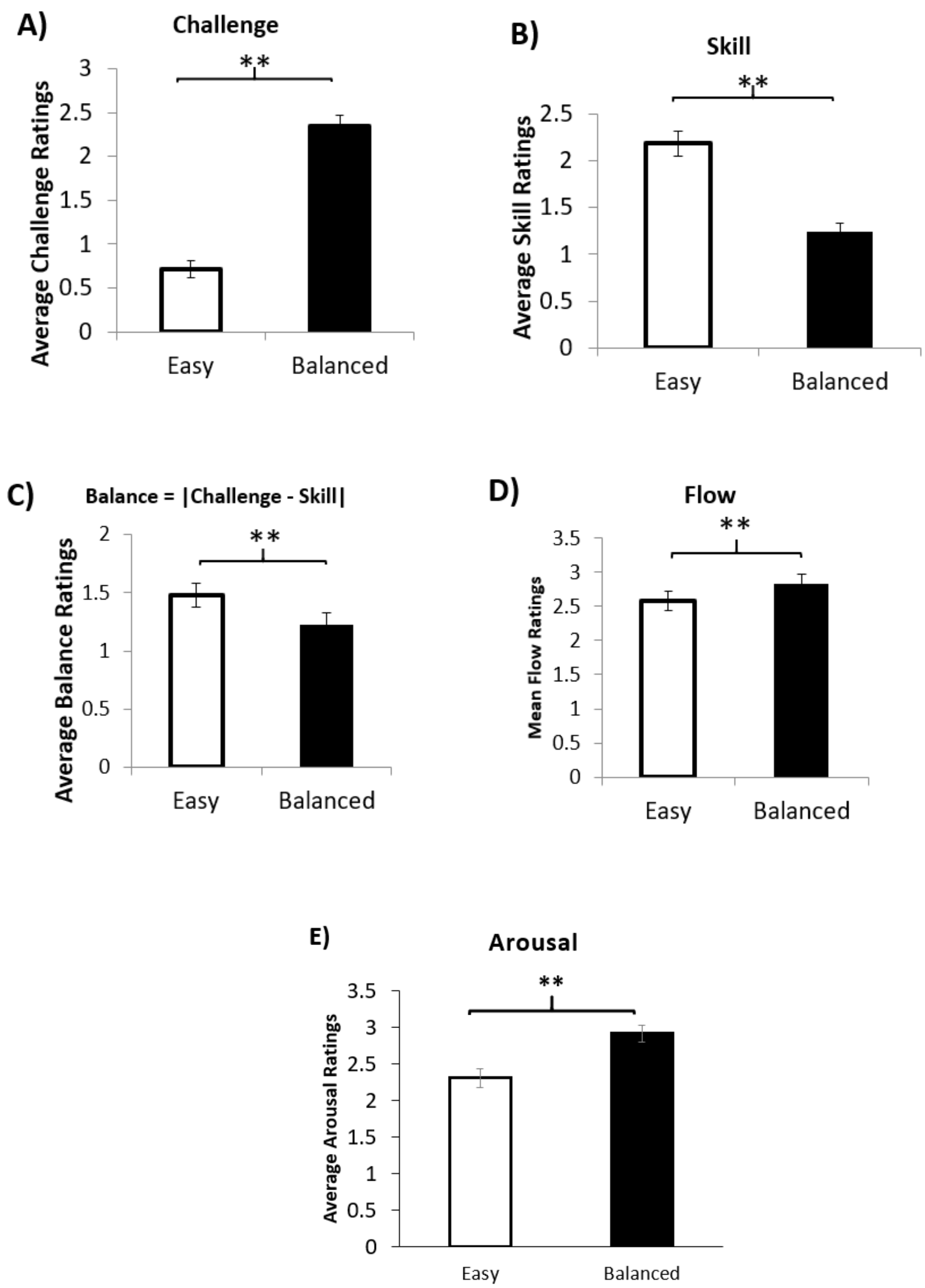

Figure 2.9 Average ratings for A) Challenge, B) Skill, C) Skill-Challenge balance (calculated as the absolute difference between skill and challenge scores, respectively), D) Flow, and E) Arousal across levels of game difficulty. Error bars ±1 SE. $**p < .01$, $* p < .05$.

Boredom and Positive Affect

Average scores for positive affect and boredom are depicted in Figure 2.10. Surprisingly, positive affect following the *easy* games was greater compared to the balanced games, $t(59) = 2.72$, $p = .008$, $d = .341$ (Panel A of Figure 2.10). We reasoned that this pattern might be attributable to the positive affect associated with winning outcomes. For the easy games all participants won each of the games. For balanced games some players (n=16) never experienced a win, only losses. Most players (n = 44) experienced at least one win, but losses were still more frequent – a situation that might have lowered positive affect. We therefore took the 44 players who had at least one balanced win, and compared their positive affect for easy wins, versus the balanced win (or wins if there was more than one). As shown in Panel B of Figure 2.10, in line with our original hypotheses, positive affect following balanced wins was significantly higher than positive affect following the easy wins, $t(43) = 4.38$, $p < .001$, $d = .519$. Indeed, although winning in Candy Crush is generally a pleasurable experience, the heightened positive affect for balanced wins illustrates the important role of feeling adequately challenged, and flow in maximizing positive affect following a rewarding outcome. Finally, boredom aligned with our predicted patterns - easy games were found to be more boring to play compared to the balanced games, $t(59) = -3.63$, $p = .001$, $d = .387$ (Panel C of Figure 2.10).

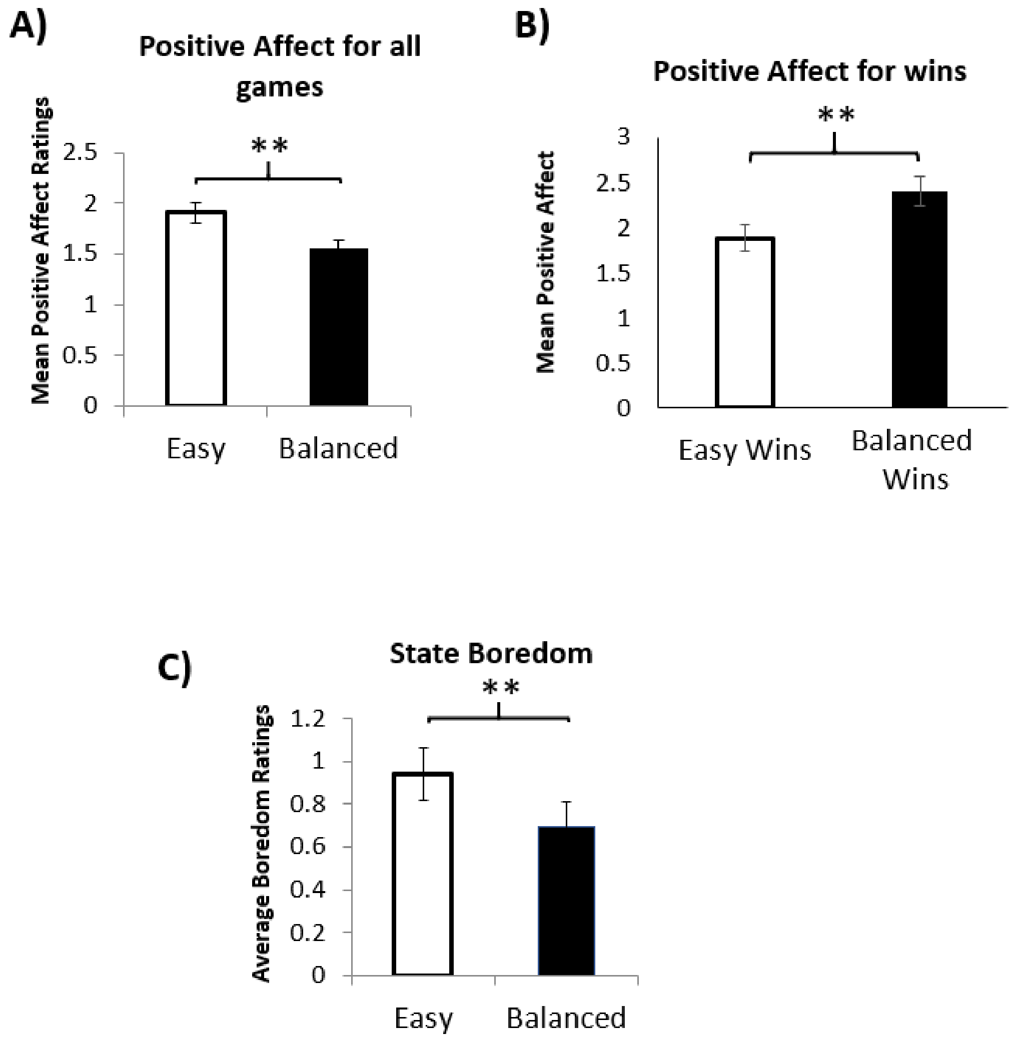

Figure 2.10 Average subjective of A) Positive Affect for all games in easy and balanced levels, B) Positive affect for easy and balanced condition wins, C) State boredom for easy and balanced levels. Error bars ±1 SE. **p < .01, * p < .05.

Arousal, Urge and Preference

In addition to players experiencing more flow and arousal for the balanced games, players also expressed more urge following balanced games compared to easy games, $t(59) = -3.76$, $p < .001$, $d = .268$ (Panel A of Figure 2.11). Hence, playing around one's level standing was not only flow and arousal inducing, but also urge inducing. Following the analytical strategy used in Experiment 1 we conducted a hierarchical multiple regression with arousal entered at Step 1 and flow entered at Step 2 of the model. At step 1, arousal accounted for 35.4% of total urge variance, $F(1,58) = 31.82$, $p < .001$. At step 2, flow accounted for an additional 6.8% of unique urge variance over and above arousal, *F-change* $(1, 57) = 6.65$, $p = .013$.

Next we assessed whether one's level of urge impacts their game preference in continuing gameplay. When prompted to select a game to continue their gameplay, a vast majority of players selected to continue playing the balanced games over the easy games. As shown in Panel B of Figure 2.11, 53 (88.3%) participants selected to continue playing the balanced games, while only 7 participants selected to continue playing the easy games (11.7%), $\chi^2 = 35.26$, $p < .001$.

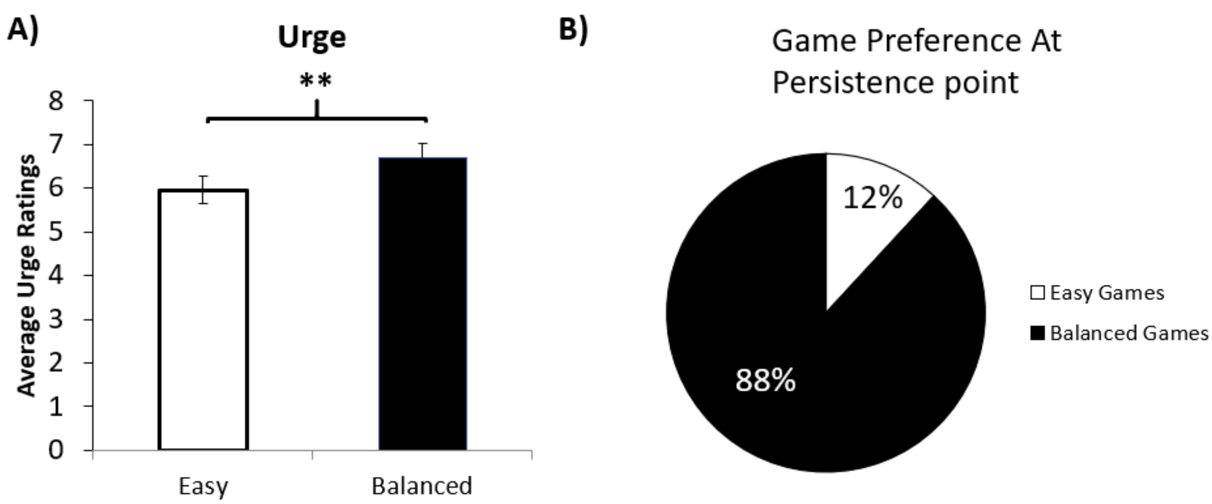

Figure 2.11 Average subjective ratings for easy and balanced games for A) Urge. B) Proportion of participants selecting to play balanced and easy games at preference point. Error bars ±1 SE. **p < .01, * p < .05.

2.2.4 Discussion

Overall, our findings aligned with our predictions informed by Experiment 1. For all players, playing around their level standing maximized the skill-challenge balance compared to playing easier games and these balanced games produced greater flow and arousal compared to easy games.

Interestingly, our analysis of positive affect scores supports the idea that although winning affects positive affect it is not the sole determinant of an enjoyable gameplay experience. When comparing easy games which players consistently won, to a mixture of the odd win amongst frequent losses, we showed that the consistent wins led to more positive affect than the balanced (mostly) losing games. Hence, and perhaps not surprisingly, winning does seem to induce more positive affect than gameplay involving mostly losing outcomes. Yet, when comparing easy wins to balanced wins – the balanced winning games triggered significantly more positive affect. Hence, winning an adequately challenging, flow-inducing game was much more rewarding compared to simply winning an easy game.

The combined findings thus far suggest that not only does the skill-challenge balance foster an enjoyable experience by means of flow and arousal, but since wins were far less frequent than losses in the balanced condition, motivating reinforcement schedules may have affected players' experience. That is players mostly lost, but occasionally won playing games near their current level standing – with these wins coming at unpredictable times. We propose that wins were likely delivered on a variable-ratio (VR) schedule of reward delivery – a reward schedule important for maintaining gaming behaviour in the short-term and long-term (Haw, 2008; Braun & Giroux, 1989; Hopson, 2001). A VR schedule with relatively low win frequency is most likely maintained when challenges are slightly above the skill level of a player. Unlike in easy games where skills dramatically exceed the game challenges (guaranteeing a win), in balanced games it is unclear to the player whether they will meet the given challenges and win. In level-based games like Candy crush, designers use a ramping structure, where players successes (leveling up) are offset by the game increasing in difficulty. This ramping up of difficulty ensures not only maintenance of the skill challenge-balance, but wins which will be low in frequency, and unpredictable in terms of when they occur – a recipe for motivating further game play.

Accordingly, we saw how balanced games led to not only more flow, more arousal, more positive affect, but also higher urge to continue playing. Importantly players appeared to act on this urge - 53 out of 60 players chose to continue playing balanced games where they might win, but would most likely lose, rather than the easy game where they were all but assured of winning. Overall, our findings show that more challenging games in mobile games like Candy Crush have marked impacts on flow and arousal, leading to players actively choosing to continue playing games that are conducive to both these motivating experiences.

Chapter 3: Escaping Boredom Analysis

3.1 Research Questions & Hypotheses

In Chapter 2 we demonstrated how a balance of challenge and perceived skill predicts optimal flow, arousal, and greater motivation (indexed by subjective urge, and game preference). Interestingly, we also demonstrated that those of higher skill playing more challenging games experienced the highest flow. In further considering the individual differences surrounding flow, in this analysis we now turn to looking at motivations to play, as motives are well documented to shape how players interact with games, as well as their subjective affective and immersive experiences.

First, we sought to replicate the robust relation between boredom proneness and depression. In terms of our predictions for boredom-prone players and playing to escape, we expected that those with elevated trait boredom proneness would more strongly endorse gaming to escape as a motivation for their gameplay. We also expected to replicate previous findings showing that gaming to escape is associated with more problems related to smartphone gaming.

Next we sought to show that players who preferentially reported gaming to escape would experience more flow, arousal, positive affect, and subsequently *less* boredom during gameplay than those who more weakly endorsed gaming to escape. To assess this hypothesis, we compared those in the upper tercile of escape scores to those in the lower tercile. Finally, motivated by the relation between escape gaming and problem gaming we then sought to show that players who strongly endorse gaming to escape would also experience a greater urge to continue playing than their low-escape gaming counterparts.

3.2 Methods

Participants

This analysis used the same sample presented in Experiment 2.

Reasons for Gaming Scale. The Reasons for Gaming Scale (RFGS; Larche et al., 2021) was used to assess player motives for gameplay. The scale features an escape motivation and excitement motivation subscale, comprising six items in total. The excitement subscale features statement items like, “I like playing casual/smartphone games mostly because I find them very entertaining and exciting”. The escape subscale features statement items such as “I like playing casual/smartphone games mostly because they take my mind off of daily worries”. Participants would indicate the extent to which they endorsed each statement on a 7-point Likert scale where *1 = completely disagree*, and *7 = completely agree*. Items were summed for each participant to create an escape motivation composite score. For this chapter only the three items corresponded to the escape subscale were analyzed (escape and excitement scores are contrasted in Chapter 4).

Boredom Proneness. The 9-item short-form Boredom Proneness Scale (BPS-SF; Struk et al., 2017) was administered to assess trait levels of boredom susceptibility outside the context of the gameplay. The scale features items such as “Unless I am doing something exciting, even dangerous, I feel half-dead and dull”, and were scored on a 7-point Likert scale with 1 indicating *‘Strongly Disagree’*, and 7 indicating *‘Strongly Agree’*. Items were summed to produce a composite boredom proneness score.

Depressive symptomology Outside the Gaming Context. The 21-item Depression Anxiety Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is a self-report instrument designed to measure the three related negative emotional states of depression, anxiety and tension/stress. For the current study only the Depression subscale was administered. Examples of the seven items of this subscale included “I felt that I had nothing to look forward to”, “I found it hard to wind down”, and “I experienced trembling (e.g. in the hands)”. Responses were scored on a 4-point Likert scale where 0 = *Did not apply to me at all* and 3 = *Applied to me very much or most of the time*. Scores were summed for each participant and multiplied by 2 to allow for comparison with the 42 item DASS measure.   Higher scores indicate more depressive symptomology.

Problem-Videogame Playing Questionnaire. The Problem Video Game Playing Questionnaire (PVPQ) is a nine-item measure that assesses problem video gaming status or video game addiction (Tejeiro-Salguero & Bersabé-Moran, 2002). We adapted this questionnaire to include language reflecting smartphone gaming as opposed to video-gaming for the present study. An example item includes ‘I spend an increasing amount of time playing smartphone games’ for which participants respond ‘*yes*’ or ‘*no*’ to each item. Items are summed (‘*yes*’ is scored as 1 and ‘*no*’ is scored as 0) to create a composite PVPQ score. Higher overall PVPQ scores are indicative of more video game related problems.

Procedure

Following the game preference phase outlined in Experiment 2, participants completed trait-level measures (RFGS, PVPQ, BPS, and DASS-21).

3.3 Results

Escape, Boredom and problematic smartphone gaming

The robust relation between boredom proneness and symptoms of depression, *r*(58) = .577, p <.001 was replicated. The more symptoms of boredom proneness experienced in everyday life, the more players endorsed gaming to escape, *r*(58) = .254, p = .050. As predicted, and similar to other domains of video-gaming, the more a player endorsed smartphone gaming to escape, the more problems related to smartphone gaming they reported, *r*(58) = .435, p = .001. Thus, it appears that gaming to escape aversive feelings tied to boredom proneness specifically was related to problematic smartphone gameplay.

Contrasting escape gamers to non-escape gamers

To test our predictions about whether those who game to escape would experience greater flow, arousal, positive affect, urge and less boredom we compared players falling into the upper tercile of all escape scores (n = 20; *M* = 10.05), to those falling in the lower tercile (presumably non-escape players (n = 20; *M* = 19.25). We used a tercile analysis rather than, for example a median split, since for those participants in the middle third of escape scores, those just above the median and those just below the median would likely be more similar to one another than those sampled from more extreme ends of the escape score continuum. Thus, the smaller power incurred by analyzing fewer subjects would theoretically be offset by an increased effect size caused by greater group differences between the upper and lower terciles.

We first examined the level of flow experienced during gameplay for escape and non-escape players playing the easy and balanced games. A mixed-model repeated measures ANOVA revealed a significant main effect of difficulty level, $F(1, 38) = 15.59$, p <.001, η_p^2 =

.291, a main effect of tercile, $F(1, 38) = 11.21$, $p = .002$, $\eta_p^2 = .228$, but no tercile by difficulty interaction, $F(1,38) = .00$, $p = 1.0$, $\eta_p^2 = .000$. The main effect of difficulty level was driven by the greater flow during the balanced games compared to the easy games. In accordance with our prediction the main effect of tercile was driven by the more profound flow experienced by players in the upper tercile of escape scores compared to those in the lower tercile. Surprisingly, this effect of escape tercile was of similar magnitude across the easy and balanced games (see Figure 2.12, panel A).

For arousal (Figure 3.1, Panel B), a mixed-model repeated measures ANOVA revealed a significant main effect of difficulty, $F(1,38) = 19.54$, $p < .001$, $\eta_p^2 = .340$, no main effect of tercile, $F(1,38) = 3.30$, $p = .077$, $\eta_p^2 = 0.08$, but a tercile by difficulty interaction, $F(1,38) = 5.01$, $p = .031$, $\eta_p^2 = .117$. The main effect of difficulty was driven by the greater arousal experienced in the balanced game condition. Simple effects analyses revealed that the interaction was attributable to those in the upper tercile of escape experienced greater arousal than non-escape players, but *only* in the balanced game condition ($p = .018$), not for the easy game condition ($p = .335$).

Next, we looked at levels of positive affect experienced during winning gameplay for the upper and lower terciles of escape (Figure 3.1, Panel C)[5]. As expected there was a significant main effect of difficulty level on positive affect ratings, $F(1,38) = 20.58$, $p < .001$, $\eta_p^2 = .407$, a main effect of tercile, $F(1,38) = 1.68$, $p = .046$, $\eta_p^2 = .101$ (with those in the upper tercile

[5] Here we directly compared easy and balanced winning outcomes only since the previous analysis for all participants revealed that positive affect was dampened by losses.

experiencing greater positive affect), but no tercile by difficulty interaction, $F(1,38) = .1.68$, $p = .204$, $\eta_p^2 = .053$.

For boredom (Figure 3.1, Panel D), a mixed-model repeated measures ANOVA revealed a main effect of difficulty level, $F(1,38) = 14.68$, $p < .001$, $\eta_p^2 = .279$, no main effect of tercile, $F(1,38) = .886$, $p = .353$, $\eta_p^2 = .023$, and no tercile by difficulty interaction, $F(1,38) = 1.01$, $p = .320$, $\eta_p^2 = .026$. The main effect of difficulty was driven by the higher boredom overall for the easy games compared to the regular games. Although those in the upper tercile nominally appeared less bored than those in the lower tercile (especially in the balanced game) the large error bars convey that boredom ratings were highly variable reducing statistical power.

Finally, for urge (Figure 3.1, Panel E), a mixed-model repeated measures ANOVA revealed a significant main effect of difficulty, $F(1,38) = 12.02$, $p = .001$, $\eta_p^2 = .240$, no main effect of tercile, $F(1,38) = 2.95$, $p = .094$, $\eta_p^2 = .072$, but a tercile by difficulty interaction, $F(1,38) = 6.13$, $p = .018$, $\eta_p^2 = .139$. The main effect of game difficulty was driven by the greater urge to continue gameplay in the balanced condition over the easy condition for all players. Simple effects analyses indicated that the tercile by difficulty interaction was caused by those in the upper tercile of escape scores experiencing greater urge to play than the lower tercile of escape scores for the balanced games ($p = .028$), but not for the easy game condition ($p = .346$).

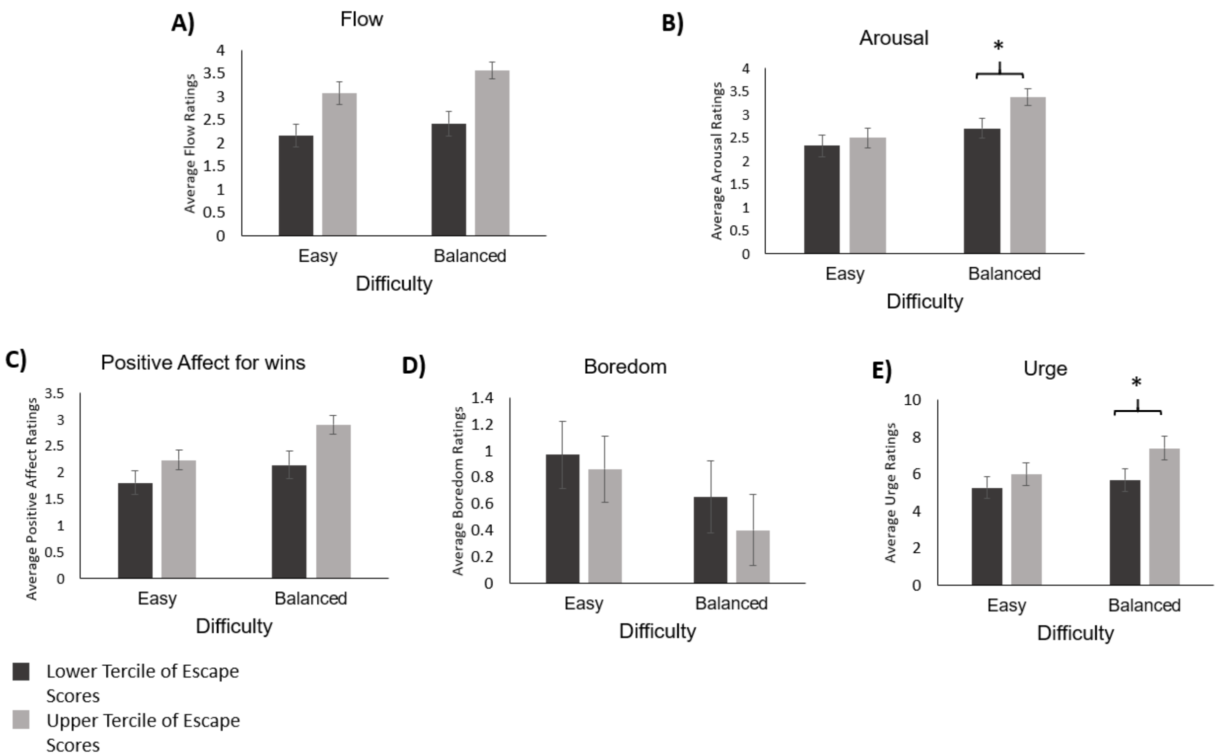

Figure 3.1 Average subjective ratings for upper and lower tercile of escape scores across easy and balanced games for, A) Flow ratings, B) Arousal C) Positive Affect for wins, D) State Boredom, E) Urge. Error bars ±1 SE. **p < .01, * p < .05.

3.4 Discussion

Escaping Boredom and Implications for Problematic Gaming

In line with past findings in the gaming and gambling literature, playing to escape was related to increased negative consequences related to problematic smartphone gaming (Kardefelt-Winther, 2014; Baker et al., 2004). Typically, in other games made for desktop platforms, those endorsing playing to escape tend to also report experiencing high levels of negative affect, such as depressive symptomology in everyday life (Deleuze et al., 2018; Hagstrom & Kaldo, 2014; Kaczmarek & Drązkowski, 2014; Larche et al., 2021). Similarly, in the current study smartphone game players who play to escape primarily endorsed experiencing boredom proneness in everyday life, which was in itself related to greater depressive symptomology. Such findings suggest that those who are susceptible to boredom in everyday life might more frequently engage in smartphone play to escape feelings of monotony or lack of engagement in other aspects of daily life, and thereby avoid any subsequent negative affect stemming from their boredom. Hence, gaming to avoid aversive moods and mentations tied to boredom increases the likelihood of experiencing negative consequences in the long-term (Kardefelt-Winther, 2014).

Findings of the current study also showed that escape smartphone players experienced greater flow, arousal and positive affect during gameplay compared to their non-escape counterparts. Those who escape by playing smartphone games like Candy Crush became more immersed during gameplay than non-escape players – surprisingly even during easy games. However, only the optimally challenging balanced games were capable of triggering heightened arousal for escape players compared to non-escape players. They also experienced more positive affect than non-escape players – a finding which is important in terms of the rewarding, and motivating properties of games. If escape players find these games more rewarding, they may play longer and more often. Indeed, if these games are capable of alleviating the negative affect associated with boredom, it sets up a circuit of negative reinforcement that may lead to addiction.

Contrary to our predictions, there were no statistical differences between escape and non-escape players in our measures of state boredom during gameplay. Since we tested only those highly familiar with Candy Crush (who had mastered at least 70 levels) our sample may have included only those who find this game inherently appealing - thereby restricting the range of boredom during game play. Future studies might gauge the degree to which gameplay reduces state boredom from a baseline task immediately before game play to assess whether there is a steeper reduction in boredom for escape players moving from a highly bored state at baseline to an engaged state during gameplay. Nevertheless, although boredom did not differ between groups, we were able to demonstrate that trait boredom proneness in everyday life was correlated with the degree to which players endorsed gaming to escape.

Intriguingly, this rewarding experience of profound flow and arousal among escape players, particularly for the balanced games had a marked impact on their urge to continue playing these games. To our knowledge this is the first gaming research that demonstrates that this heightened flow, arousal and positive affect translates to more enhanced motivation to prolong gameplay in those who game to escape. The corroborating patterns between arousal and urge especially among escape players during the most flow-inducing games confirms the motivational force of these games for players who are seeking to alleviate negative affect and the hypo-arousal associated with boredom. This link is especially reinforced by our finding (in Chapter 2) that flow accounted for additional urge variance over and above arousal for all players.

Chapter 4: Escaping Negative Affect in Desktop Games[6]

4.1 Experiment 3

4.1.1 Research Questions and Hypotheses

Our analysis in Chapter 3 revealed that those who play smartphone games to escape preferentially experienced greater flow and positive affect during gameplay when playing optimally challenging games compared to those who do not play for escape. They also experienced greater urge to play during these games. In Experiment 3, we aimed to identify whether this effect can be observed in other immersive game genres. An additional component of Experiment 3 is a correlational assessment between escapism and depression and whether this correlation, if found, would also be observed among those who game for excitement rather than escape.

The central focus of this experiment was to explore more specific hypotheses involving the link between flow states, and the positive affect associated with them, and escape gaming in in role-playing games (RPGs). Specifically, we contrasted those who strongly endorsed engaging in game play as a means of escaping negative thoughts, to other players who lacked such escape motivations. If players game to escape they should report greater symptomology of negative affect (e.g., depression) outside of the game context. Also, in accordance with previous studies of problem gamblers (Dixon et al., 2017; Dixon et al., 2018) it was predicted that escape

[6] Major parts of this chapter are taken directly from Larche, Tran et al. (2021).

gamers will experience deeper flow states during play than those who do not play to escape. Furthermore, since flow is known to be associated with positive affect, we predicted that not only would those who endorse gaming to escape experience more flow, they would also experience more positive affect during game play than those who do not play to escape.

To test these hypotheses we used the RPG game *The Elder Scrolls V: Skyrim*. This game allowed flexible in-game editing that enabled us to create in-game baseline conditions where players simply walk down a corridor, and in-game experimental conditions involving solving puzzles and interacting with other game characters. We employed an ABBA design in which players completed a baseline, two consecutive game epochs followed by a second baseline epoch. We predicted that all players would experience increases in excitement during game play, but those who endorse gaming to escape would experience greater flow and positive affect during an RPG game than players who less strongly endorse this motivation.

4.1.2 Methods

Participants

Fifty-nine undergraduate students were recruited through the University of Waterloo's Research Experience Group online recruitment system for extra credit toward a psychology course. Pre-screen questions ensured that the sample of participants: (1) were recreational gamers who played videogames at least once in the past 4 weeks, (2) had prior experience playing first person shooter or role-playing video games, (3) were not in treatment for problem gaming or gaming addiction. This study had been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee.

Materials

Reasons for Gaming Scale. The same scale featured in Chapter 3 was used in the current study and framed in terms of videogame play as opposed to smartphone gaming. Items on both escape and excitement subscales were summed respectively for each participant to create one escape motivation and one excitement motivation composite score. A binary "forced choice" question was also included to assess whether escape motivations were distinct from excitement motivations. The forced choice question was "Please choose the phrase which best describes your reasons for gaming" to which they could choose either "Gaming for excitement" or "Gaming for distraction".

Flow and Positive Affect. Scales were identical to those used in Chapter 2.

Depression Outside of the Gaming Context. Scale was identical to that used in Chapter 3.

Arousal/excitement. Bradley & Lang's, (1994) Self Assessment Manikins were used to gauge subjective reports of arousal (see Figure 2.1). For the purposes of the current experiment, labels were added to each Manikin for clarification. The labels were from left to right: *No Excitement, Mild Excitement, Moderate Excitement, Strong Excitement, Very Strong Excitement.*

Apparatus

The Elder Scrolls V: Skyrim. Participants played a modified version of an open world action Role Playing Game (RPG) played on high video settings with a resolution of 1280x1050.

The gameplay experience was limited to pre-determined sections of the game's main storyline (called 'Dungeon' levels) as well as modified sections of the game world.

Game Platform. The game was played on a lab PC running Windows 10 Professional (64bit), Intel i7-3820 quad core @ 3.60GHz, 8GB of RAM and an AMD Radeon HD 6570 with 2GB of video RAM. The monitor used was an LG W2242 22" screen with a resolution of 1280x1050. Players controlled their avatars using a generic plug and play keyboard and mouse.

Survey Platform. All questionnaires were administered via a Samsung Galaxy Tab Pro 10.1 tablet to access Qualtrics, an online survey platform.

Experimental Design

In the ABBA design the "A" epochs were the control epochs and "B" epochs involved gameplay. In the five-minute control epochs, players were asked to navigate through a pre-prepared dungeon which was stripped down to remove all puzzles, and other avatars. Players could not deviate beyond the dungeon or interact with anything but this stripped-down environment.

For the experimental epochs (depicted in Figure 4.1), each participant played two game sessions of equal length and difficulty. Game difficulty was set to "Normal" for most players but changed to "Easy" if participants indicated that they were less experienced with the game, or "hard" for those with more than 25 hours of game experience. Experimental epochs involved pre-selected dungeons, consisting of tasks and puzzles to solve. Dungeons were chosen that could be navigated within 15 minutes. The two dungeons of the experimental epochs were similar in design, puzzle structure (i.e., both symbol matching puzzles), puzzle difficulty, “enemy” structure and enemy difficulty. The dungeons were accessed via saved game states to ensure a consistent starting point and game progression.

Figure 4.1 Depiction of procedure. The experiment adhered to an “ABBA” design, with A representing the control conditions and B representing the experiment conditions. Participants started with the first control condition where they navigated a stripped-down dungeon environment for 5 minutes, followed by the experimental condition where they played versions of the enriched dungeons in Skyrim. Participants completed the GEQ and SAMs surveys following each epoch.

Avatar Characteristics

In RPGs the gameplay experience is very dependent on the abilities of the game avatar. To maximize consistency across participants and across sessions these abilities were pre-set and locked. The character was a “fighter” (a character that does not use magic) with the following abilities: One-handed sword skill, Shield Skill, Light Armour skill. The experimenters created a male and a female avatar with identical equipment, weapons and armour in their inventory. Participants chose the gender of the avatar they wished to play.

Procedure

After signing the consent form, participants were provided instructions, and the first control dungeon was loaded for participants to navigate. After 5 minutes, participants were interrupted to complete the GEQ questions and SAMs. The experimenter then loaded the first (enriched) game dungeon. Participants were then instructed to play through the dungeon for as long as instructed. After 15 minutes of game play the experimenter re-administered the GEQ and SAMs. The second enriched dungeon was loaded, participants played for 15 minutes, then completed GEQ and SAMS items. Participants then walked through the final stripped-down control dungeon for 5 minutes and completed the final GEQ and SAMs items.

Participants then completed the DASS-21 and Reasons for Gaming Scale on Qualtrics and were given a debriefing letter explaining the nature of the experiment and assigned their credit.

4.1.3 Results

Of the 59 participants, two participants asked to withdraw from the experiment and all their data was excluded from the analysis. One participant had incomplete data and therefore was also excluded from the analysis. This left a total of 56 participants.

Negative Affect (Depression) and Game Play Motivation

To quantify players reasons for game play, we totaled the three “escape” related items (the odd numbered items on the Reasons for Gaming Scale) to create an “Escape Score” and totaled the three “excitement” items (the even numbered items in the Reasons for Gaming Scale) to create an “Excitement Score”.

To assess if there were any relationships between depression related symptomology and gameplay motivation, correlations were conducted between Escape and Excitement scores and depression scores on the DASS-21. There was a significant positive correlation between escape scores and depression, $r(54) = .296$, $p=.027$ but no correlation between excitement scores and depression, $r(54) = .015$, $p=.915$.

Data Reduction and Analysis Strategy for Arousal, Positive Affect and Flow

Using a similar approach to the analysis in Chapter 3, to test the hypotheses concerning game play motivation we ranked players based on their total escape scores. We then divided the sample into terciles based on these totals. We compared the participants falling in the upper tercile of escape scores (presumably the escape gamers; n = 19), to those falling in the lower third of escape scores (presumably those who game for other reasons than to escape; n = 20).

Table 4.1 contrasts 19 participants in the lower tercile and the 20 participants in the upper tercile (the upper tercile had one extra participant due to tied scores). The table shows the average escape scores and the average excitement scores in these upper and lower terciles. Consistent with the notion that all players are drawn to videogames because of their exciting properties both the lower and upper terciles show equivalent excitement scores, $t(37) = 1.21$, *p*

=.234. Less surprisingly (given the tercile procedure), the upper tercile escape scores were much higher compared to the lower tercile escape scores, $t(23.39) = 11.70$, $p < .001$.

The table shows that for those in the lower tercile of escape scores, their excitement scores were significantly higher than their escape scores. For the escape gamers in the upper tercile the converse was true - their escape gaming scores were significantly higher than their excitement gaming scores.

Table 4.1 *Mean escape and excitement scores (standard deviations in brackets) of the upper and lower terciles of participants based on their escape scores.*

Tercile	Escape Scores	Excitement Score	t-test	significance
Lower (n=19)	11.26 (2.684)	16.63 (1.707)	t (18) = 7.195	p<.001
Upper (n=20)	19 (1.076)	17.35 (1.981)	t (19) = 3.943	p=.001

In the lower tercile, 17 of the 19 players answered "gaming for excitement" in response to the force choice item, and 2 players answered "gaming for distraction". In the upper tercile 12 players answered "gaming for distraction" with 8 players indicating "gaming for excitement" as their primary motivation.

Players' arousal (using the SAMs), positive affect and flow items were analyzed using mixed model factorial ANOVAs with block (A1,B1,B2,A2) as the within factor and tercile as the between factor. In addition to main effects of block and tercile (and their interaction), due to their theoretical importance, we conducted six planned comparisons in this ABBA design. We contrasted the first Control condition to the first Game condition (A1 vs B1), and the second game condition to the second control condition (B2 vs A2). We also contrasted the upper and lower terciles at each block. Since there were six contrasts, we used a Bonferoni correction to assess the significance of each of these contrasts (setting alpha at .008) Greenhouse-Geisser corrections were applied to instances where violations of sphericity were found.

Gaming Motivation, Arousal, Flow and Positive Affect

Arousal/Excitement ratings (using the SAMs) for those in the upper and lower terciles of excitement scores across the ABBA blocks are shown in panel A of Figure 4.2. For arousal there was a main effect of block, $F(3, 111) = 48.437$, $p < .001$, $\eta_p^2 = .567$, no effect of tercile $F(1,37) = 1.308$, $p = .260$, $\eta_p^2 = .034$ and no tercile by block interaction $F(3,111) = 1.193$, $p = .315$, $\eta_p^2 = .031$. In terms of our a priori contrasts dictated by the ABBA design, arousal rose significantly from Control 1 ($M = 2.43$, $SD = .871$) to Game 1($M = 3.30$, $SD = .784$; $t(55) = 9.157$, $p < .001$), and fell significantly from Game 2 ($M = 3.46$, $SD = .762$) to Control 2 ($M = 2.18$, $SD = .917$; $t(55) = 9.104$, $p < .001$). There were no differences between terciles at any of the four blocks (all p values $> .059$).

For the next set of results, it is important to note that the central predictions regarding motivation to escape involve greater flow and positive affect *during gameplay* (demonstrated by a tercile x block interaction).

Panel B of Figure 4.2 depicts the means of flow for those in the upper and lower tercile of escape scores across the four blocks. There was a main effect of block, $F(2.32, 87.03) = 29.681$, $p < .001$, $\eta_p^2 = .445$, a main effect of tercile, $F(1,37) = 9.091$, $p = .005$, $\eta_p^2 = .197$, but no tercile by block interaction $F(2.35, 87.03) = .707$, p = .518). As expected, a priori contrasts dictated by the ABBA design showed that flow significantly increased from Control 1 (M =1.98, SD =.884) to Game 1 (M =2.43, SD =.899; $t(55) = 4.881$, $p < .001$), and fell from Game 2 (M =2.65, SD =.829) to Control 2 (M =1.56, SD =1.169; $t(55) = 8.08$, $p < .001$). Those in the upper tercile of escape scores had significantly greater flow scores than those in the lower tercile, but only in the game epochs ($t(37) = 2.971$, $p = .005$ for Game 1; $t(37) = 3.566$, $p = .001$ for Game 2). For the control epochs these contrasts were not significant ($t(37) = 1.89$,p =.066 for control 1; $t(37) = 1.93$, $p = .061$, for Control 2).

Panel C of Figure 4.2 depicts the means of positive affect for those in the upper and lower tercile of escape scores across the four blocks. There was a main effect of block, $F(2.53, 93.67) = 35.664$, $p < .001$, $\eta_p^2 = .491$, a main effect of tercile $F(1, 37) = 9.813$, $p = .003$, $\eta_p^2 = .210$, but no tercile by block interaction, $F(2.53, 93.67) = .405$, $p = .716$, $\eta_p^2 = .011$. As expected, a priori contrasts dictated by the ABBA design showed that positive affect significantly increased from Control 1 (M =2.05, SD =.952) to Game 1 (M =2.70, SD =.877 ; $t(55) = 6.639$, p < .001), and fell from Game 2 (M =2.69, SD =.903) to Control 2 (M =1.71, SD =.1.060 ; $t(55) = 7.732$, p <.001). Those in the upper tercile of escape scores had significantly greater positive affect scores than those in the lower tercile, but only in Control 1, $t(37) = 2.844$, $p = .007$, and in Game 1, $t(37) = 3.31$, p =.002. For, Game 2 ($t(37) = 2.28$, p=.028), and Control 2 ($t(37) = 1.991$, p = .054) these contrasts failed to exceed the Bonferoni correction (alpha = .008).

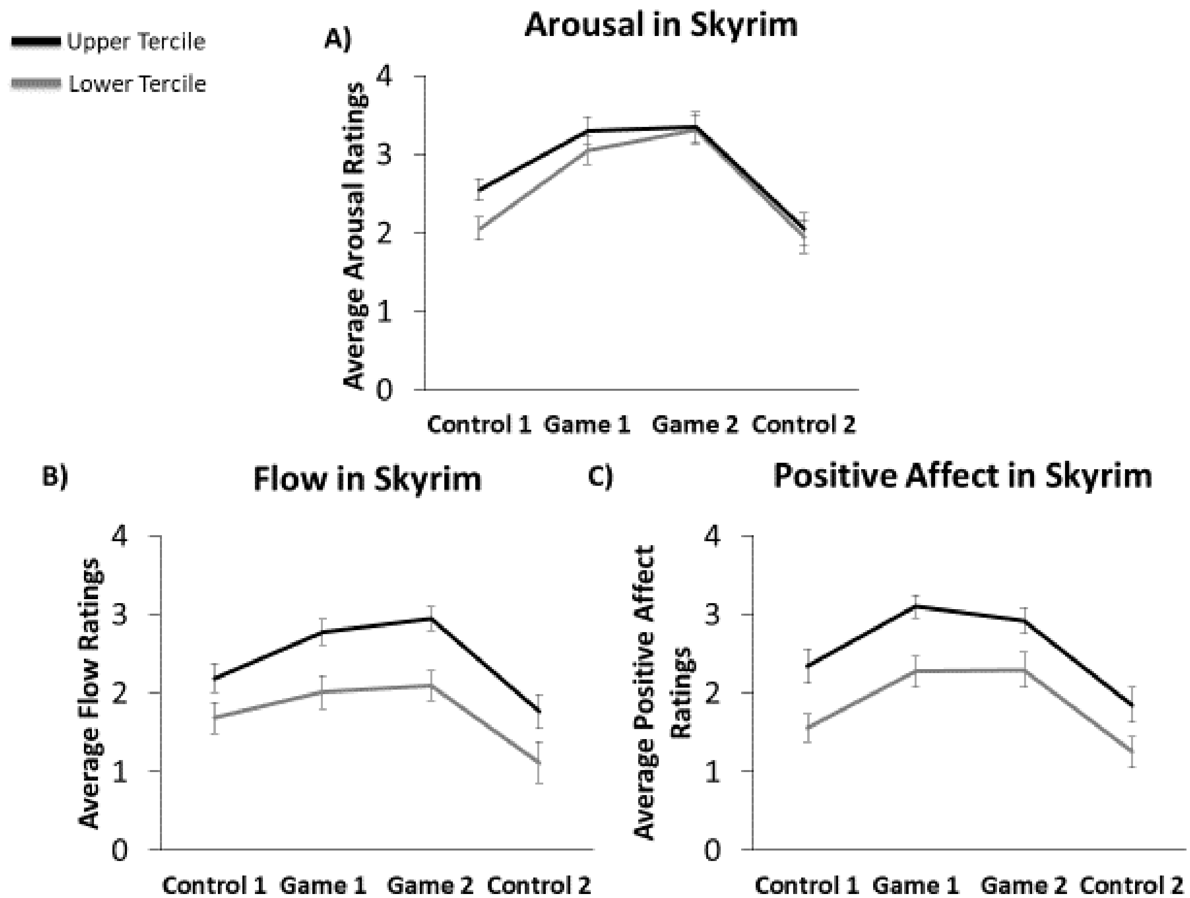

Figure 4.2 Experiment 3 Subjective responses following each epoch in the ABBA design (Control 1, Game 1, Game 2 and Control 2) by upper and lower tercile of escape scores. a) Average subjective ratings of arousal, b) Average flow ratings, and c) Average positive affect ratings. Error bars ±1 SE.

The patterns shown in Figure 4.2 contrasting those in the upper and lower terciles of escape scores were verified using correlations conducted on the entire sample. Since the key tercile predictions (and the majority of findings) involved differences during game play we restricted the correlations to the first and second game blocks of the ABBA design. Firstly, escape and arousal during gameplay in Skyrim was not significantly correlated at game 1, *r*(54)

= .199, p = .141, nor game 2, $r(54)$ = .046, p = .739. Next, escape and flow scores were positively correlated in both game 1, $r(54)$ = .409, p <.001, and game 2 , $r(54)$ = .444, p < .001. Finally, like the tercile analysis, escape and positive affect were correlated in game 1, $r(54)$ = .348, p = .009, but not game 2, $r(54)$ = .218, p = .106.

4.1.4 Discussion

In support of our hypothesis involving gaming to escape, we showed a significant correlation between depression scores on the DASS-21 and the degree to which players endorsed the escape items on the Reasons for Gaming Scale (RGS). By contrast there was no relation between excitement scores on the RGS and depression. These findings suggest that while all types of gamers are motivated in part by excitement, those gamers who play RPGs to escape, may do so to avoid the depression that characterizes their everyday lives.

A somewhat surprising finding was the less-than-perfect correspondence between the upper and lower terciles in escape scores and players answers to the forced choice question involving their primary reason for game play. While almost all (17 out of 19) players in the lower tercile indicated that they gamed for the excitement, almost half (8 out of 20) players indicated that they too gamed for excitement with only a slight majority indicating that they gamed for distraction. One possibility is that it is difficult, and artificial for players to choose only a single reason for game play. A second possibility is that the term "gaming for distraction" was seen by some players as somewhat pejorative, and possibly indicative of a "problem". Thus, by polling both excitement and escape gaming with multiple Likert-style items, we derived a more sensitive measure of those who preferentially game to escape than the single forced choice item.

Having multiple items on the escape component caused escape scores to fall on a continuum with reasonable variability between escape scores across participants. This in turn allowed us to compare those on the upper end of this continuum (escape gamers) to those on the low end of these scores. Based on our tercile analyses, we showed no difference in escape versus non escape gamers in arousal/excitement but strong differences in flow and positive affect. These patterns were verified using correlations involving the entire sample. Playing Skyrim led to heightened arousal and excitement compared to simply moving around in the stripped-down dungeon (the control conditions). Consistent with the notion that all players are attracted to video games for their excitement, there were no differences between escape players and non-escape players on their excitement during game play. The more important findings involve the contrast between escape gamers and non-escape gamers in flow and positive affect during game play. In Experiment 3 we found that escape gamers experienced greater flow, and (at least in the first game epoch) greater positive affect than non-escape gamers – a pattern that we also verified using correlations on the entire sample.

Such findings are consistent with the notion that some players may use the flow state to escape depression. In this experiment, those with higher depression scores more strongly endorsed gaming to escape, and those in the upper tercile of escape gaming scores experienced greater flow and greater positive affect than non-escape gamers. Taken together these findings suggest that escape gamers may be using video games as a form of negative reinforcement. While not gaming, their thoughts may be characterized by depression. While gaming the immersive flow experiences of the games stop them from ruminating on depressive thoughts – and game play leads to positive affect via the flow experience.

4.2 Experiment 4

4.2.1 Research & Hypotheses

Our intriguing findings in Experiment 3 showed greater flow and positive affect among those with high escape motivations during Skyrim gameplay. A question of interest is whether this effect is generalizable to other games, or whether it is only facilitated by the unique structural characteristics of RPGs. Specifically, if there is something about the immersive properties of RPGs that preferentially promote flow and positive affect, then we might not expect to see differences between escape gamers and non-escape gamers in different types of video games. One goal of Experiment 4 was to test this possibility. We chose an "arcade" style desktop game called *Winterbells* as a contrast to Skyrim. In this game, rather than solving puzzles, navigating elaborate dungeons and interacting with other avatars in an immersive fantasy world, players simply cause a rabbit to jump from one bell shaped platform to another. Each successive jump causes the rabbit to jump higher and earns points for the player.

Another aim of Experiment 4 was to gain a more comprehensive understanding of escapism as it relates to problematic gameplay involving players who primarily play desktop games. In Experiment 3 we showed that those who endorse playing to escape also showed higher depression scores outside of the gaming context. Such a finding is conceptually similar to research with depressed problem gamblers. Dixon et al. (2019a) proposed that depressed slot machine players may have problems with mind-wandering in everyday life, and that the thoughts of these players would gravitate to depressing thoughts. Dixon et al. proposed that such players may find relief from these dark thoughts when playing multiline slot machines because the intermittent celebratory feedback of the slot machine may serve to rein in the attention of players and prevent their minds from wandering to dark places. In support of their contentions, they showed those with high depression ratings in everyday life, also experienced mindfulness problems in everyday life, but slot machines seemed to rein in the wandering minds of these players leading to flow, and positive affect. One goal of Experiment 4 was to assess whether those who strongly endorsed escape gaming, might, like their gambling counterparts, also show mindfulness problems in everyday life. If so then they too might find relief from thinking about negative thoughts when playing video games. Such negative reinforcement may lead to problematic forms of video game play.

In sum we sought to show that those video gamers that report high levels of depression would also show mindfulness problems in everyday life. If these players find relief through game play, they might also endorse gaming to escape as a key motivator for their game play. Given that this is a maladaptive means of coping with depressing thoughts, we predicted that endorsing escape as motivation for game play would lead to higher scores on a scale of problematic play, than endorsing excitement as a motivation for game play.

4.2.2 Methods

Participants

A total of 65 participants were recruited from the SONA pool at the University of Waterloo. Pre-screen questions ensured that the sample of participants: (1) were recreational gamers who played videogames at least once in the past 4 weeks, (2) were not in treatment for disordered video-gaming.

Apparatus

Winterbells Game. We selected an "arcade" platform game called 'Winterbells' developed by Orisinal Games. In this game, players interact with the computer mouse to make a rabbit move and jump. The goal is to persistently climb up the vertical game map by jumping on a series of platforms that look like bells. Players make the rabbit jump by clicking on the mouse, and move the mouse side to side to land on horizontally spaced bells that appear to be falling slowly to the bottom of the game board. For each successful landing on a bell platform, players accumulate points. If a player misses one of the bell platforms, the cartoon rabbit then falls to the bottom of the game board, losing all progress and forcing the player to start at the very beginning of the game.

Game Platform. The Winterbells game was played on a Macintosh computer (iMac 20-inch, early 2009) running OS X version 10.11.6.

Materials

Reasons For Gaming Scale. Administration and scoring of the RGS was identical to Experiment 3.

Flow and Positive Affect. Measures for flow and positive affect were identical to Experiment 3.

Depression Outside of the Gaming Context. Administration and scoring of the depression subscale of the DASS-21 was unchanged from Experiment 3.

Arousal/Excitement. Measures for arousal were identical to Experiment 3.

Mindfulness and attention in everyday life. The Mindfulness Attention and Awareness Scale (MAAS; Carlson & Brown, 2005) assesses attentional problems participants may encounter in everyday life. The scale features 15 items, consisting of statements such as “It seems I am ‘running on automatic’, without much awareness of what I’m doing”. Participants indicate the degree to which the statements resonate with them on a 6-point Likert scale, with *1 = almost always*, and *6 = almost never*. Total scores on this scale are summed and averaged, with lower scores indicating less mindfulness and attentional focus on tasks in everyday life.

Problematic Video-gaming. Measures of Problem Video-gaming the same as Experiment 3 (wording modified to reflect videogaming rather than smartphone gaming).

Experimental Design

Similar to Experiment 3, Experiment 4 used an ABBA design with “A” representing the control epochs and “B” the experimental epochs. For control epochs the player simply moved, but did not click the mouse. Hence the rabbit moved from side to side but since it never “jumped”, the bell platforms simply fell to the bottom of the game board and no points were gained. The control epochs contained all the visual components of the game epochs, but no element of game play. There was a minor difference in time length in Experiment 4, such that the experimental and control epochs were each 5 minutes in length (the experimental epochs were 5 minutes in length as opposed to 15 as in Experiment 3). The 15-minute experimental epoch length for Experiment 3 was selected due to the time necessary to complete the Skyrim dungeon's puzzles. Winterbells was simpler to grasp, thus having 5 minutes of play was deemed sufficient in Experiment 4.

Procedure

The testing protocol was identical to Experiment 3. Participants were asked to play a few practice rounds of Winterbells for approximately 3 minutes followed by the four blocks in the ABBA design. At the end of each five-minute block, participants were interrupted by the researcher to complete the in-game measures of arousal, flow and positive affect. Upon completing the final in-game survey for the last (control) block, participants then completed a questionnaire containing the DASS-21, the RGS, the MAAS and the PVPQ.

Analytical Strategy

In Experiment 4 we first looked at the interrelations among gameplay motivation, depression, mindfulness and problematic gaming. We then used the tercile analytical strategy to assess whether escape gamers experienced greater flow and positive affect for the arcade game. Finally, using the tercile analyses, data from the role-playing game in Experiment 3 and the arcade game in Experiment 4 were directly compared.

4.2.3 Results

A total of 65 participants were recruited from the SONA pool at the University of Waterloo.

Negative Affect (Depression) and Game Play Motivation

To assess if there were any relationships between depression and gameplay motivation, correlations were conducted between Escape and Excitement scores from the Game Motivation Questionnaire and depression scores on the DASS-21. Escape scores were marginally positively correlated with depression, $r(63) = .236$, $p = .059$. Excitement scores were significantly correlated with depression scores on the DASS-21 but the correlation was negative – those with greater excitement ratings had *lower* depression scores, $r(63) = -.288$, $p = .020$. As an exploratory analysis to supplement this unexpected finding, a Fisher's r-to-z transformation test revealed that the two correlations were significantly different from each other, suggesting that gaming to escape is more positively related to depression than gaming for excitement, $Z = -3.14$, $p = .001$.

Escape scores were positively correlated with severity of problematic videogame play, $r(63) = .321$ $p = .009$, while there was no relationship between excitement scores and problematic gameplay, $r(63) = .135$, $p = .285$. Finally, escape scores were negatively correlated with mindfulness in everyday life, $r(63) = -.332$, $p = .009$ (indicating those who game to escape had more problems with mind-wandering in everyday life), whereas there was no relation between excitement scores and mindfulness problems $r(63)= .130$, $p =.303$.

Data Reduction and Analysis Strategy for Arousal, Positive Affect and Flow

Terciles were created based on escape scores in a manner similar to Experiment 3. In Experiment 4, there were 22 participants in the lower tercile (with escape scores that ranged from 3 to 12). In the upper tercile there were 19 participants with scores of 17 and above. To have equal numbers of participants in both terciles, three participants had to be selected who had escape scores of 16. Since there were 6 participants tied at 16, the three participants with the lowest excitement scores were selected to complete this upper tercile.

Table 4.2 shows the average escape scores and the average excitement scores for those in the upper and lower terciles of escape scores. Consistent with the notion that all players are drawn to video-games because of their exciting properties, both the lower and upper terciles show equivalent excitement scores, $t(42) = -.776$, p = .442. Unsurprisingly (given the tercile procedure) those in the upper terciles had markedly higher escape scores than those in lower terciles $t(31.638) = 12.808$, p < .001.

Table 4.2 *Mean escape and excitement scores (standard deviations in brackets) of the upper and lower terciles of participants based on their escape scores*

Tercile	Escape Scores	Excitement Scores	t-test	Significance
Lower (n = 22)	9.00 (3.06)	16.55 (2.74)	t (21) = 7.995	$p < .001$
Upper (n = 22)	18.41 (1.593)	17.18 (1.981)	t (21) = 2.247	$p = .036$

In the lower tercile, 19 of the 22 players answered “gaming for excitement” in response to the force choice item with only 3 players answering “gaming for distraction”. In the upper tercile 12 players answered “gaming for distraction” with 10 players indicating gaming for excitement.

Arousal, positive affect and flow data were analyzed using mixed factorial ANOVAs with block (A1,B1,B2,A2) as the within factor and tercile as the between factor. As in

Experiment 3, we contrasted the first Control condition to the first Game condition (A1 vs. B1), and the second game condition to the second control condition (B2 vs A2). We also contrasted the upper and lower terciles at each block. Since there were six contrasts, we used a Bonferoni correction to assess the significance of each of these contrasts (setting alpha at .008) Greenhouse-Geisser corrections were applied to instances where violations of sphericity were found.

Gaming Motivation, Arousal, Flow and Positive Affect

For arousal there was a main effect of block, $F(1.90, 80.002) = 126.41$, $p < .001$, $\eta_p^2 = .751$, but no effect of tercile $F(1,42) = .006$, $p = .937$, $\eta_p^2 = .000$, and no tercile by block interaction, $F(1.90, 80.002) = 2.072$, $p = .135$, $\eta_p^2 = .047$. In terms of our a priori contrasts dictated by the ABBA design, arousal rose significantly from Control 1 (M =1.46 , SD =.533) to Game 1 (M =3.12, SD =.820; $t(64) = 15.38$, $p < .001$), and fell significantly from Game 2 (M =2.85, SD =.833) to Control 2 (M =1.29, SD =.522; $t(64) = 13.89$, $p < .001$). There were no differences between terciles at any of the four blocks (all p values > .163). The arousal responses for the escape and non-escape gamers across the ABBA blocks are shown in Panel A of Figure 4.3.

Panel B of Figure 4.3 depicts the means of flow for those in the upper and lower tercile of escape scores across the four blocks. There was a main effect of block, $F(1.52, 64.086) = 87.511$, $p < .001$, $\eta_p^2 = .676$, no main effect of tercile, $F(1,42) = .102$, $p = .751$, $\eta_p^2 = .002$, and no tercile by block interaction, $F(1.52, 64.086) = 1.976$, $p = .157$, $\eta_p^2 = .045$. As expected, a priori contrasts dictated by the ABBA design showed that flow significantly increased from Control 1 (M =.62, SD =.606) to Game 1 (M =2.26, SD =1.058; $t(64) = 13.008$, $p <. 001$), and fell from Game 2 (M

=2.06, *SD* =1.099) to Control 2 (*M* =.44, *SD* =.562; *t*(64) = 12.332, *p* <.001). There were no differences between terciles at any of the four blocks (all p values > .061).

Panel C of Figure 4.3 depicts the means of positive affect for those in the upper and lower tercile of escape scores across the four blocks. There was a main effect of block, *F*(1.486, 62.40) = 68.789, *p* < .001, η_p^2 = .621, a main effect of tercile , *F*(1,42) = 5.136, *p* = .029, but no tercile by block interaction *F*(1.486, 62.40) = 1.289, *p* =.276, η_p^2= .030. As expected, a priori contrasts dictated by the ABBA design showed that positive affect significantly increased from Control 1 (*M* =.70, *SD* =.809) to Game 1 (*M* =2.19, *SD* =.907; *t*(64) = 11.973, p < .001), and fell from Game 2 (*M* =2.04, *SD* =.990) to Control 2 (*M* =.56, *SD* =.831; *t*(64) = 10.79, *p* <.001). Although those in the upper tercile of escape scores had greater positive affect scores than those in the lower tercile in all four blocks, none of these contrasts fell below the Bonferoni cutoff of .008 (smallest p-value = .010 for the second control condition).

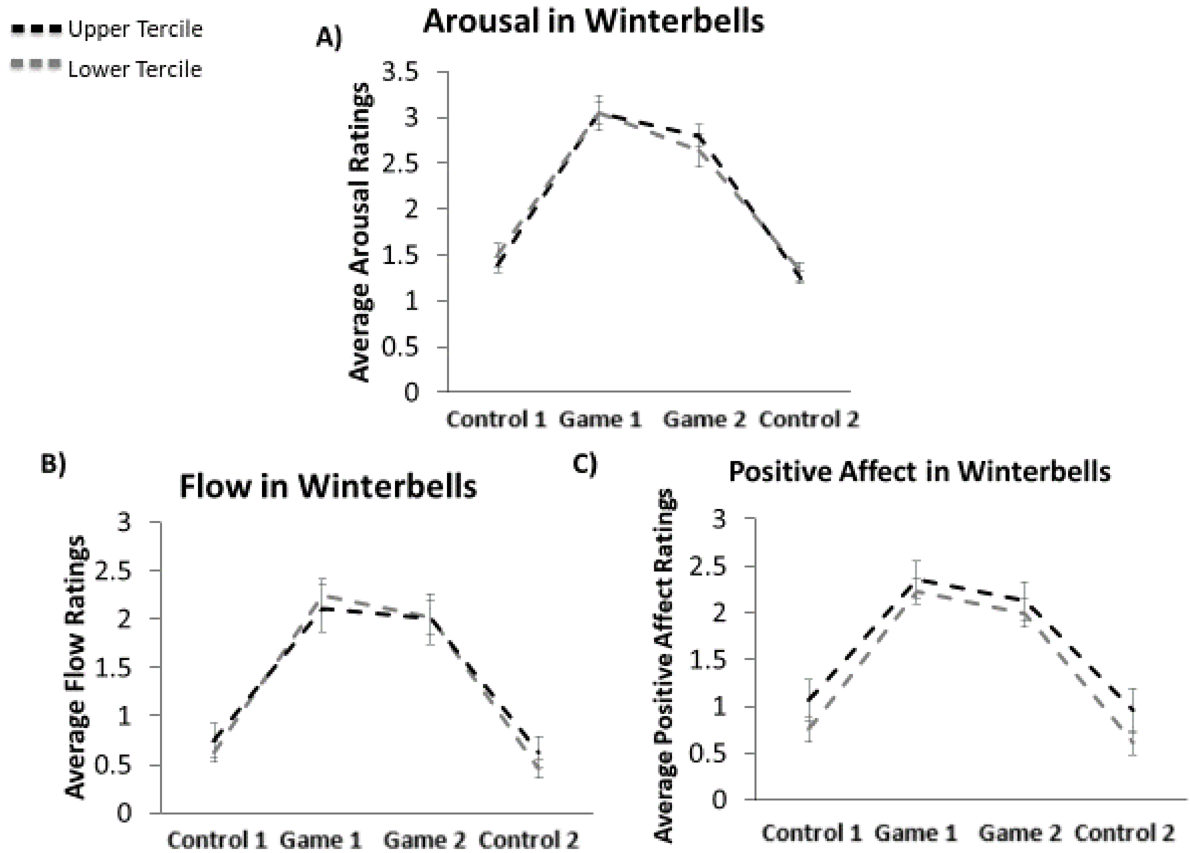

Figure 4.3 Comparison of Subjective responses for Experiment 2 following each epoch in the ABBA design (Control 1, Game 1, Game 2 and Control 2) by upper and lower tercile of escape scores. a) Average subjective ratings of arousal, b) Average flow ratings, and c) Average positive affect ratings. Error bars ±1 SE.

For Winterbells, where the upper and lower escape terciles showed similar averages for arousal, flow and positive affect, the analysis on the entire sample showed that these scores were not significantly correlated with escape scores during gameplay. Specifically there was no correlation between arousal and escape in game 1, $r(63) = .051$, $p = .685$, or game 2, $r(63) = -.093$, $p = .463$. Next, flow was not significantly correlated with escape scores in game 1, $r(63) =$

-.038, p = .766, or game 2, $r(63)$ = .040, p = .754 . Finally, positive affect was not correlated with escape in game 1, $r(63)$ = .098, p = .436, or game 2, $r(63)$ = .117, p = .353.

4.2.4 Discussion

The correlation between escape scores and depression approached, but fell just short of significance. Yet in this experiment we showed that the more one endorses excitement gaming, the *fewer* symptoms of depression they experience. While the reasons for this latter (unpredicted) association are unclear, it may suggest that excitement motivation for gameplay is a healthy motivation for this type of recreation. Of more pertinent theoretical importance, the fact that the correlations between excitement motivation and depression scores and escape motivation and depression scores were opposite in sign (and significantly different from one another) is telling. It suggests that while excitement motivations may be a healthy motivation for gaming, escape motivations may be a more maladaptive and unhealthy coping mechanism. While greater escape scores were only marginally correlated with depression scores, escape scores *were* significantly associated with mindfulness problems in daily life as indexed by the MAAS. By contrast, excitement scores were unrelated to mindfulness problems. Such findings support our hypotheses that, similar to their problem gambling counterparts in Dixon et al., escape players likely experience mindfulness problems possibly related to their depressive rumination when they are not gaming. Furthermore, in terms of problematic play, we also show that greater escape endorsements were associated with videogaming-related problems as measured by the PVPQ, whereas excitement scores were unrelated to such problems. This mirrors previous findings regarding the relationship between escape gaming and gaming related problems.

4.3 Statistically comparing reactions of RPG players to Platform Arcade Game players

4.3.1 Summary of analysis

To recap, in Experiment 3 we demonstrated that escape players experienced greater levels of flow and positive affect while playing an RPG game compared to non-escape players. However, these effects did not generalize to an Arcade-style platform game analyzed in Experiment 4. Next we took the opportunity to statistically compare the reactions of those who played the RPG game (Experiment 3) to those who played the arcade game (Experiment 4).

4.3.2 Results

For arousal, flow and positive affect, data were analyzed using a mixed factorial analysis of variance with block as the within factor, tercile (lower third of escape scores, upper third of escape scores) and Game (RPG Skyrim, Platform Arcade Winterbells) as between factors. For all analyses the main effect of block was caused by game epochs leading to greater arousal, flow and positive affect. For brevity, block effects are only described below if they interacted with either game or tercile, and only significant effects are reported.

For arousal there was a main effect of block $F(2.511, 198.361)= 159.20$, $p < .001$, $\eta_p^2 = .668$. There was a main effect of game $F(1,79) = 24.317$, $p < .001$, $\eta_p^2 = .235$ (with Skyrim generating more arousal [M=2.70], than Winterbells, [M = 2.119]). There was also a significant interaction between block and game, $F(2.511, 198.361) = 7.376$, $p<.001$, $\eta_p^2 = .085$. This was caused by greater arousal in Skyrim in both control blocks and Game 2 (all p values <.001), but equivalent arousal in Game 1. This interaction can be seen in Figure 4.4.

For flow there was a main effect of block $F(1.940, 153.221) = 105.9$, $p < .001$, $\eta_p^2 = .573$, and a main effect of game $F(1,79) = 22.132$, $p < .001$, $\eta_p^2 = .219$ (with Skyrim generating more flow [*M* =2.07], than Winterbells, [*M* =1.36]). There was also a significant interaction between block and game, $F(1.940, 153.221) = 14.441$, $p < .001$, $\eta_p^2 = .155$. This was caused by greater flow in Skyrim in both control blocks and Game 2 (all p values <.001), but equivalent flow in Game 1. There was also a main effect of tercile $F(1,79) = 5.935$, $p = .017$, $\eta_p^2 = .070$. Those in the upper tercile showed greater flow (*M* =1.896) than those in the lower tercile (*M* =1.514). This main effect was qualified by a game by tercile interaction, $F(1,79) = 4.006$, $p = .049$, $\eta_p^2 = .048$. Simple effects revealed that while those in the upper tercile of escape scores experienced significantly greater flow than those in the lower tercile while playing Skyrim ($p = .004$), the average flow scores were equivalent across terciles while playing Winterbells ($p = .751$). This game by tercile effect is shown in Figure 4.4.

For positive affect there was a main effect of block $F(1.974, 155.918) = 99.74$, $p < .001$, $\eta_p^2 = .558$, and a main effect of game, $F(1,79) = 28.178$, $p < .001$, $\eta_p^2 = .263$ (with Skyrim generating more positive affect [*M* =2.2], than Winterbells, [*M* =1.35]). There was also a significant interaction between block and game, $F(1.974, 155.918) = 5.874$, $p = .004$, $\eta_p^2 = .069$. While Skyrim generated greater positive affect across all four blocks (smallest p value = .002), these differences were especially pronounced in the control conditions (e.g., for control 1 Skyrim triggered an average positive affect rating of 2.05 vs .70 for Winterbells; for control 2, *M* =1.71 for Skyrim, *M* =.46 for Winterbells). There was also a main effect of tercile, $F(1,79) = 14.886$,

$p<.001$, $\eta_p^2 = .159$, caused by those in the upper tercile showing greater positive affect (M =2.09) than those in the lower tercile (M =1.505).

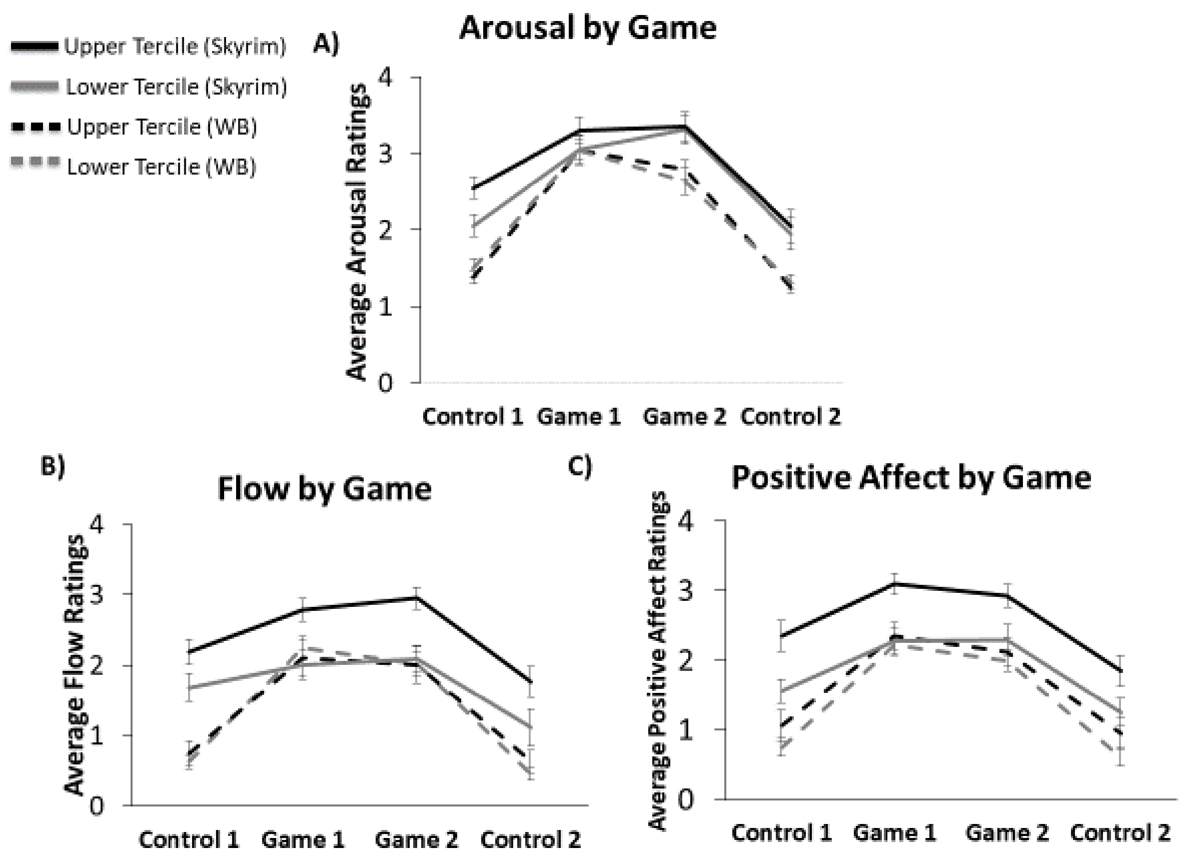

Figure 4.4 Comparison of Subjective responses for each game type following each epoch in the ABBA design (Control 1, Game 1, Game 2 and Control 2) by upper and lower tercile of escape scores. a) Average subjective ratings of arousal, b) Average flow ratings, and c) Average positive affect ratings. Error bars ±1 SE.

Interestingly, our two game types had very different impacts on flow, arousal and positive affect. Specifically, it is clear that players had more enhanced experiences of arousal, flow and positive affect during our selected Role-Playing game than during the arcade game regardless of whether players fell in the upper or lower terciles of escape scores. We attribute these robust differences to the strong immersive properties unique to our selected Role-Playing game. This is especially evident when comparing players' more robust scores when wandering through a stripped-down dungeon for the control conditions of Skyrim. It is reasonable to assume that even though the control dungeons were impoverished compared to the actual game dungeons, wandering through the impoverished dungeons was still much more engaging than monotonously sliding a mouse back and forth in the control conditions for the arcade game.

More importantly, compared to non-escape players, escape players experienced more profound experiences of flow and positive affect in Skyrim. By contrast, flow and positive affect scores did not differentiate between escape and non-escape players in Winterbells. Such patterns of results suggest that escape gamers may only experience profound flow and enjoyment when in games that are especially designed to be especially immersive. We provide a more detailed comparison between the game's structural characteristics in the general discussion.

4.3.3 Discussion

Our findings in Chapter 4 demonstrate that during RPG gameplay, escape gamers displayed more profound flow and positive affect than non-escape gamers, but this effect did not translate to our platform arcade game. In fact, our role-playing game was much more exciting and immersive to players regardless of whether they played for escape or not, lending credence to existing research showing that RPGs promote higher degrees of immersion (Johnson et al., 2012). Our novel findings highlight how this deep level of immersion fostered by RPG games may act as a powerful medium for escape players to withdraw successfully from reality (Hussain, 2009; Hilgard et al., 2013).

In general, our in-game assessments of flow and positive affect show that players who play for escape may find relief through the enjoyment of experiencing flow, but effective escape may depend on whether the game itself is especially conducive to flow. It is clear that the structural characteristics in games are important determinants of whether players are able to fulfill their psychological, dictated ultimately by their reasons for play.

Chapter 5: General Discussion and Conclusion

5.1: Mechanism of Flow in Smartphone Games: Motivating characteristics of Challenge in complex difficulty games

It is first interesting to consider how challenge acts as a motivational characteristic in smartphone games. At the end of Chapter 2, we discussed the relationship between the skill-challenge balance and the experience of flow under two models of flow that are currently coexisting in the positive psychology literature: The classic model of flow and the quadrant model of flow. The current research clarifies the relationship between the skill-challenge balance in predicting flow in the context of Smartphone games, as well as the experimental manipulation of flow for the purpose of the study of videogames.

Specifically, to sustain optimal flow and arousal, game designers go to great lengths to maintain a balance of skill and challenge. The skill-challenge balance is classically defined as the extent to which players feel the challenges of a given game align closely with their skills (not too easy or too hard). Several studies have found that players typically report low flow and low arousal for games that are too easy (Baumann et al., 2016; Engeser & Reinberg, 2008; Keller & Bless, 2008; Keller, Ringelhan, & Blomann, 2011; Keller, Bless, Blomann & Kleinböhl, 2011; Kennedy et al. 2014; Tozman et al., 2017; Jin et al., 2012; Johnson et al., 2012). As previously discussed, both models have different implications for the onset of flow during a game according to a player's particular skill level and progress point in the game. Under the classic model of flow, players are posited to enter flow regardless of their skill level – so long as there is a balance of challenge and skill. By contrast, under the quadrant model, only once players have developed high skills can they experience flow.

In both Experiments 1 and 2, we mirror previous research by showing that both flow and arousal increase when players feel that the game challenges slightly exceed or are equal to their skill (Baumann et al., 2016; Engeser & Reinberg, 2008; Keller & Bless, 2008; Keller, Ringelhan, & Blomann, 2011; Keller, Bless, Blomann & Kleinböhl, 2011; Kennedy et al. 2014; Tozman et al., 2017). Specifically, when playing Candy-Crush games that were too easy players reported a lack of skill-challenge balance, low flow, low arousal and high boredom. For games that more adequately matched their skill level they reported greater flow, more arousal and less boredom. Importantly, the games in the balanced condition were also shown to trigger a stronger urge to continue gameplay than the easy games. This shows that such a model continues to have some explanatory value for games that are easy versus games that are balanced.

However, the findings in Experiment 1 contrast with previous findings when players were introduced to the much harder games, and points towards a new understanding of the relationship between challenge and flow in games. Specifically, despite finding the harder games more objectively challenging than the balanced games, they nevertheless produced comparable flow, arousal and urge to play compared to the balanced games. I propose that one reason for this may be because highly challenging complex games might not disrupt players' sense of control or agency during play – which is also an important characteristic to the maintenance of flow experience (Vuorre & Metcalfe, 2016; Chen, 2007). Consider the classic game Tetris (which researchers used to demonstrate that games which are too hard resulted in a drop-off in flow). In speed-based games like Tetris, a player must react reflexively to increasing demands in order to succeed. If a speed-based game is too fast, players may lose a sense of control – they feel they are unable to interact with the game at all – a situation which may thwart flow. In Candy-Crush, however, players are not bound to any time constraint, and even in very, very difficult games they still feel in control – capable of planning and executing the moves they must make in order to play the game. From these findings we can perhaps therefore propose that there are two "categories" of difficult games – those which, though highly difficult, can still be played, and those which are unplayable. In the too-hard but playable games, high levels of flow will still be experienced. In the too-hard but unplayable games, flow will be reduced to levels comparable to games that are far too easy.

Our findings thus have implications for the use of videogames in experimental paradigms investigating flow and the hypotheses associated with future research. In particular I propose that the specific means by which difficulty is manipulated must be taken into account in order to properly form hypotheses concerning whether flow will, or will not be experienced. Indeed, a balance between challenge and skill is not absolutely necessary for the production of flow for games whose extreme difficulty depends on complexity (Jin et al., 2012). As such, whether one gets an inverted U relation between difficulty levels (too easy, balanced, or too hard) and flow will depend on how difficulty is manipulated. If speed is the means by which difficulty is manipulated, then the inverted U relation between difficulty and flow will emerge. If complexity is the means by which difficulty is manipulated a different relationship between difficulty and flow will emerge. Specifically, in games that are made very difficult via complexity, players will still maintain a sense of control, and a sense that the game is difficult but still playable. Under such conditions players will still experience flow.

The experiments presented in this thesis have implications for how the various quadrants in the different flow models are best described. Situations in which challenge far outweighs skill have been labelled using the term anxiety (see Panels A and B of Figure 1.1). When anxious, our hearts beat faster, and our palms begin to sweat – in other words there is an increase in arousal. In the studies presented, easy games were the least arousing to play compared to the regular games. However, hard games were just as arousing as regular games. While arousal failed to differentiate between the balanced and the too hard games, frustration was able to differentiate these conditions. Although, admittedly we did not measure subjective anxiety per se, I would argue that players may also become anxious even in the balanced games since during these balanced games players cannot be sure whether they will succeed or fail. We would therefore suggest that a more appropriate label for situations in which challenge clearly outweighs skill is frustration. Here we show that frustration conforms to all perturbations of the skill challenge balance – it is low in easy games, higher in regular games and highest in games that are too hard. Thus, given the ambiguous results we show with arousal, frustration may be a superior concept to demarcate situations where challenge far outweighs skill. All of this points towards a more nuanced approach to questions of flow in gaming – whether or not flow will be experienced in very difficult games may depend on the specific game genre, and how difficulty is manipulated in the games.

5.2 Individual Differences in Skill, Performance, and Flow Experience

This research also yielded new insights into individual differences in skill, and how those factor into whether or not flow is experienced. In Experiment 1, we highlighted findings at the individual level that contradict the classic model's assumptions that flow entry depends on the balance of challenge and skill. In Experiment 1, (see Figure 2.7) we showed that there were a number of players who had (or nearly had) an exact match between challenge and skill yet did not experience flow. Tellingly for these participants, they all had low levels of skill. In mirroring previous research (Jin et al., 2012), players who perceived themselves as highly skilled were the ones who experienced high flow. Thus, in the context of Candy Crush, this suggests that, in line with the quadrant model, the more advanced players are the ones who experience optimal flow and motivation, whereas more novice players who are just starting out a game are more likely to experience less flow until they build up their skills. A defining feature of flow is that it is a state of deep, effortless concentration (Csikszentmihalyi, 1990). The low flow observed among novices could be explained by lack of necessary skills to feel that they were able to progress effortlessly through gameplay, and thus they may have a more difficult time entering flow compared to advanced players (Wu et al., 2013). However, this explanation warrants further research.

The current findings may have implications beyond the scope of Candy Crush. The finding that it is the highly skilled players who preferentially enter a flow state may have ramifications for any type of game requiring skill. Consider Esports – the competitive and often professional play of digital games. Esport professionals spend enormous amounts of times "training" (Witkowski, 2009) or "drilling" (Ferrari, 2013), developing reflexes comparable to that of real-world fighter pilots (Russell, 2010). Based on the findings presented in this thesis it would be of interest to assess whether these highly skilled professionals experience greater flow than those just beginning to play such games. It may well be that in reaching peak performance, deep and effortless concentration may be a pivotal state for esports players to strive for in order to perform at their highest level during a tournament.

5.3 Flow and reward – Winning isn't everything

New insights into the different sorts of rewards that players enjoy in games – beyond simply "winning" – were also uncovered in the process of this research. A common question in terms of flow, particularly in gaming or any activity involving extrinsic rewards, is being able to disentangle motivations driven by the external rewards of the game and the motivation induced by the experience of flow. In this pursuit, players experience of positive affect is key. In the easy condition where players won every time, we demonstrated that players experienced heightened positive affect, but lower flow and urge-to-play compared to when players played at their level standing. Importantly, when comparing winning in the easy and balanced conditions, the balanced wins demonstrated significantly greater positive affect. Thus, although winning in itself is a motivating, hedonic experience, our findings empirically demonstrate that the means by which the win was obtained is also a crucial contribution to a player's motivation to continue gameplay within a session. That is winning will increase positive affect, but winning a challenging game will lead to even more positive affect. Importantly, it was during the play of these more challenging games that the urge to continue playing increased.   Such a finding is important for understanding the role of flow in incentive-salience (the motivational 'wanting' component of the reward system), which is a central component characteristic of addictive behaviours (Berridge et al., 2009; Berridge & Robinson, 2003). Thus, in future research it would be beneficial to replicate, in different types of games, whether the flow experience strengthens the motivational properties of winning.

5.4 Positive Affect and Coping in Escape Players

The work presented also sheds new light on the experiences of “escape” players. Specifically, the enhanced arousal during play and elevations in the urge to play noted among bored “escape”-oriented smartphone game players in Chapter 3 may demonstrate the increased need to seek flow from these optimally challenging games as an external source of stimulation. In playing smartphone games, these players may achieve optimal arousal, engaged focus and attention, and ultimately a reduction in feelings of monotony that characterizes their day-to-day lives. Although flow is a state that accompanies many leisure activities, this heightened urge-to-play among escape players who achieve flow during gaming brings with it implications for the maintenance of problematic smartphone gaming and negative consequences. Given that one of the sequalae of flow is distortions in the experience of time, heightened flow may lead to excessive time gaming (Hull, Williams & Griffiths, 2013; Dong, Wang, Du & Potenza, 2014).

Beyond the smartphone (Candy Crush) context, this pattern of results for flow and positive affect also specifically resonates in role playing games. RPG players who gamed to escape in Experiment 3 were found to experience greater flow and positive affect than non-escape players during gameplay. This converging similarity between the two game genres is significant given how different the structural characteristics are between the games. Despite the elaborate avatars, and complex stories of the RPG games, a similar elevation of flow and positive affect were experienced by escape players playing the much simpler smartphone games. What may unify these very different types of games is the puzzle solving component that occurs in both games. Of course more research would be needed to conclusively implicate whether this feature of games is crucial to flow and positive affect.

Taken together, our findings suggest that escape gamers and non-escape gamers have very distinct experiences within and beyond gameplay. Consistent with past research in both video-gaming and gambling research, we show that gaming to escape is related to experiencing negative mood (e.g., depression) and mindfulness problems outside of gaming. Importantly, in Experiment 3 endorsing *excitement* (as opposed to escape) as a motivation to play was unrelated to depression or problems with mindfulness outside of the gaming context. If anything, the more one endorses excitement gaming, the *fewer* symptoms of depression they report (at least in Experiment 4). These opposing relationships for excitement and escape motivations with depression more firmly ground our findings within a negative reinforcement framework – escape players may be using gaming as a way to distance themselves from negative thoughts and feelings in daily life. Unfortunately such a coping strategy is maladaptive since engaging in game play to escape one's problems, is accompanied by a higher risk for the development of problems related to gaming.

In many ways the relations between escape gaming and depression uncovered in Experiment 3 and 4 mirrors that found in the gambling literature. During multiline-slots gambling depressed players experience profound flow, and its consequent positive affect – a situation that makes multiline-slots highly rewarding. A similar pattern emerges here - those who endorse gaming to escape experience high levels of flow and positive affect during (non-gambling) game play. The similarity between the contexts is important given the disparity between multiline slots gambling and RPGs. In multiline slots flow seems to be linked to the frequency of reward. Those playing multiple lines experience more frequent rewards than those playing single line games, and they also experience more flow. In RPGs rewards are relatively infrequent – in the current study most players correctly solved two puzzles over fifteen minutes. In multiline slots games players would receive positive feedback far more frequently (in some games nearly every other spin). Thus, profound flow may be experienced in the two contexts for very different reasons, again pointing to the importance of considering the specifics of different gaming contexts. One clear difference between gaming and slots gambling involves skill. While there is no skill in slots, there is obviously skill in video-games. Thus, the means to achieving flow may be very different in slots games versus video games. In slots, effortless concentration may be experienced by the external reining in of attention through the intermittent presentation of attention-capturing celebratory flashing lights and jingles. For video games flow may be achieved through the balance of skill and challenge. The fact that greater skill predicts greater flow, is important since many games, (including games like Candy Crush) use a ramping structure, where as players skill increases, the game compensates by getting harder. Such ramping structures may cause an upwardly spiraling increase in flow – as skills monotonically increase in video games – so too does flow.

While slots and video games may induce flow in different ways the fact that flow induces distortions in time may impact players in similar fashion regardless of whether they are gambling or gaming. Not realizing how much time has passed in the flow state may itself increase the potential for problems associated with excessive gameplay, especially if playing longer and more frequently interferes with other aspects of daily life (Hull et al., 2013).

5.5 Game Genres Conducive to Flow

Recall that we showed that escape players experienced more flow than non-escape players in both a simple cell phone game (Candy Crush) and in an RPG with elaborate avatars and fantasy worlds. It is clearly not the case, however, that all games are equally appealing to escape gamers.

In examining two types of games played on a desktop (e.g., one RPG and a platform arcade game), the pronounced differences in flow, positive affect and arousal between our RPG and the arcade platform game are likely rooted in the structural characteristics unique to each game genre. Relevant antecedents of flow in a video-game include: game play in which players feel a strong sense of control and action fluency, player skills match the challenges presented in the game, and there is a clear goal and unambiguous feedback in the game (summarized in Fong et al, 2015; Sweetser & Wyeth, 2005; Chen, 2007; Wenke, Fleming & Haggard, 2010). Even the connection to one's avatar can have an impact on the level of flow experienced in gameplay (Soutter & Hitchens, 2016). Most RPGs like Skyrim encompass these properties. For instance, Skyrim promotes a sense of control and action fluency by giving players sufficient time to plan and execute their actions to solve the dungeon puzzle. This also allows for a balance between perceived challenges and skills in the game, since players have sufficient time to make correct moves. By contrast, Winterbells requires players to persistently make quick and accurate moves in order to avoid falling back to the bottom of the game board. With each successful jump, the game gets harder; the bells fall more quickly, and become smaller in size. Eventually, the challenge of the game starts to outweigh the skills players have causing the rabbit to fall. After a fall, the game starts over, and the skill that they accrued in the previous game, at least in early portions of the next game, may far exceed the challenge. This may easily throw off the skill-challenge balance, hence making it more difficult to enter flow (Wenke, Fleming & Haggard, 2010). The design of Winterbells is such that although fun to play, the frequency of negative feedback falling (i.e., failing) is far more frequent than in RPGs. Thus, the structural characteristics in games like Winterbells may hinder flow for escape players, while the combination of characteristics in Skyrim is more conducive to flow and its key sequalae – positive affect.

In summarizing the influence of game genre on flow and escape it is interesting to note that two very different types game genres (Candy Crush and Skyrim) were both able to show elevations of flow among escape players compared to non-escape players, but the arcade-style game Winterbells did not. As aforementioned, in both Candy Crush and Skyrim players must solve different types of puzzles whose difficulty varies via complexity. In Winterbells, as the game avatar climbs higher and higher, the player is forced to make their jumps more quickly – in other words game difficulty is at least in part manipulated by speed. In this game there was no difference in the flow experienced by escape and non-escape players. Clearly game genre makes a difference in the ways which it influences flow, and its potential attractiveness to escape players.

Interestingly, in the classic studies of flow and the skill challenge balance, one only finds an inverted-U relation between flow and difficulty when difficulty was manipulated by speed. In this thesis we showed that game genre matters in how the flow difficulty relations manifest – in games where difficulty is manipulated by complexity, we do not get the Inverted U-shaped function – rather an inverted L shaped function where too easy games lead to low flow, but balanced AND too hard games both lead to greater flow. Thus, to fully understand flow one needs to consider the different game genres.

5.6 Limitations and Future Directions

Although Experiment 1 and 2 yielded compelling findings with respect to flow, positive affect and urge-to-play, as with all research it is not without its limitations. In this case, although we had players indicate their *intentions* to continue gameplay, whether or not this actually translates to behavioural persistence remains to be explored. In a similar vein, although we showed that players preferentially opted to play the balanced games more often than the easy games in experiment 2, due to the relatively low numbers of players choosing the easy games we were not able to show that players choosing the balanced games actually played longer. Future studies might consider a between-subjects design where equal numbers of players are exposed to easy or balanced games, and after a fixed number of games players would enter a persistence phase in which they could then play for as long as they wished. It does not seem unreasonable to suggest that if flow prolongs gameplay sessions, (especially among escape gamers), we would find that those playing balanced games would play longer than those playing games that were too easy. This potential disjuncture between intended and actualised future play is an interesting direction for future studies to explore, but one that was not addressed here.

We also note that Candy-Crush is a mobile game that features microtransactions (e.g., opportunities to purchase or gain additional features or "power-ups" that may advance gameplay). This inherent aspect of gameplay was disabled in this current study in order to standardize play as much as possible between participants. The role of microtransactions, and how they influence flow, is an interesting line of enquiry that was not assessed in these studies.

Another limitation concerns the breadth of our measure of flow. As aforementioned flow is a complex construct with multiple antecedents and consequences, including time distortion, loss of self-awareness and action-awareness merging. We assessed flow using only the flow component of the Game Experience Questionnaire rather than other extant measures of flow that may probe more adequately all of the antecedents and sequalae of flow. Future studies might therefore also consider measuring these other facets in a game setting to afford a more comprehensive understanding of the mechanism of flow in the digital gaming context. Lastly, since Candy-Crush is only one example of a game which varies difficulty via complexity rather than speed, future research should aim to reproduce our results using other games varying difficulty by varying complexity.

In terms of Experiments 3 and 4, our game type comparison was based on a between-subjects analysis. A more statistically powerful approach moving forward would be to make comparisons of multiple games within the same sample as opposed to two distinct samples. More generally, future researchers should also consider investigating which particular genres subjectively appeal most to those with specific gaming motives. While we tacitly assumed that those games which produced the highest positive affect for escape gamers (relative to non-escape gamers) would be more appealing than those games (i.e., Winterbells) where such differences did not emerge, we did not explicitly contrast which type of games players found most appealing. Secondly, there were also subtle differences in game play duration between the different studies. Specifically, the game epochs in Skyrim were slightly longer compared to the game epochs in Winterbells. This was because due to the complexity of Skyrim's game goals, the game conditions in Skyrim required a longer time commitment for players to work through the game in a meaningful way. For Winterbells, the game's goals were much simpler and thus did not warrant a longer playing time. Future research aiming to compare games in a within-subjects design should aim to select games with equal epoch lengths.

5.7 Applications in Gaming Harm Reduction

The combined findings suggesting that escape players are vulnerable to potentially playing for longer than intended can inform how smartphone game designers can develop and implement safeguards aimed to reduce the emergence of negative consequences for these players. Adding features that increase one's self-awareness that is otherwise lost when locked in a state of flow has been suggested as a promising route to temporarily disrupting flow (Schüler, 2012). Some practical examples from the electronic gambling literature include the addition of voluntary pop-up messaging, such as reminders of approaching time-limits during play, as one way of helping gamblers exit flow to reflect on their behaviour (Delfabbro & King, 2020; Bjørseth et al., 2021). Players of videogames in general have expressed positive attitudes towards the incorporation of similar features in videogames to help reduce negative consequences associated with increased time spent playing (Stevens et al., 2021).

5.8 Conclusion

In conclusion, the current program of research provides a nuanced perspective of the relationship between the skill-challenge balance and flow as it emerges in games of complex difficulty. We also demonstrate the importance of expertise in the skill-challenge balance, since our findings suggest that more advanced players may be more susceptible to the deep, immersive experience of flow. This research also sheds light on the contribution of the flow experience, negative mood and problematic video-game play among players who game to escape.

The classic skill-challenge balance model of flow may not capture the experience of gamers playing games with a complex difficulty structure since players experienced higher flow in both balanced and games that were far too difficult. Flow was also a highly invigorating experience in the context of mobile game play, which from a harm perspective suggests a heightened potential for problems in players experiencing higher degrees of immersion.

Indeed, this program of research supports existing research showing that gaming to escape is a motive that is more related to gaming problems, and more generally negative moods outside of the gaming context. By contrast, gaming for excitement appears to be less problematic (Hellstrom et al., 2012; Kardefelt-Winther, 2014a). The rewarding and enjoyable state of flow may be a valuable state for escape players in particular, given its ability to provide relief from rumination through increased focus and attention, as well as positive feelings that they might not otherwise get outside the context of a game. Findings of the current research further highlight how the structural characteristics unique to specific game genres are an imperative determinant of whether players reach their desired experience dictated by gaming motivation. Games like smartphone games and RPGs seem to possess structural characteristics that are crucial for escape players to profoundly experience the state of flow. Thus, considering game genres as well as motives are an important step for understanding risk factors for problem gaming.

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